

AN
E S S A Y

ON THE
DRAUGHT of FIRE
IN

Furnaces, Flues, and Chimnies,
And of the true Causes, Process, and Effects thereof:

Being an Intent to explain the Fundaments of the
brief Account of a

NEW INVENTION:

For which has been obtained his MA-
JESTY'S Royal Letters Patent.

It consists of a peculiar method of constructing, and setting Boilers of any dimension in Fire-Engines, Salt-Works, Brewhouses, Distilleries, Sugar-houses, and Sugar-Works abroad; and also in Allum, Copperas, Roman-Vitriol, Saltpetre-Works and Refineries thereof; in such a well contrived manner, that more than the half-part of coals and fuel may be saved, and yet a quicker and larger dispatch of business in every respect obtained.

With some Remarks about common SALT and
its Use.

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B R I S T O L:

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An ESSAY, &c.

THE draught of fire in furnaces, flues and chimnies, is of absolute necessity, else the whole would be of no use and service. But is it possible to bring any thing unto a due perfection, whereof we have no ideas and understanding? It will happen sometimes, that the thing is obtained by working at random, and then we extol ourselves as great masters! But when we attempt it a second or third time, it possibly fails, and we loose our aim and are misled! May we then be able to assign the reasons and mend it? Shall we apply to masons and bricklayers, and betray ourselves? Indeed they are masters in their business, having skill enough of mortar, stones and bricks, and able hands of working them; but who will call at their school for any account of the secrets of nature, veiled by the most wise Creator, and not without causes. The most ingenious, the most learned, the most acute heads must stop in the search thereof; a great many have gone astray and lost themselves; the most part have rejected them as things above human understanding; very few have been so happy and successful in piercing through and behind the veil, and have seen nature displayed. These have left for their disciples some obscure footsteps, to which I have duly attended. I am no master, but only a scholar, not of the first, but of the last class; and am not ashamed thereof, in the seventieth year of my age. Our knowledge at best is

only partial, not universal. All boasted perfection is liable to the reprimanding motto: *Quantum est, quod nescimus!* Therefore I do confess myself wholly incapable of answering further. I will propose only my ideas about the draught of fire, and leave to every one the full liberty of proving all things, and holding fast what is good.

It is a common saying, the fire or furnace, flue or chimney, has a good and strong draught; and on the contrary, they have no draught at all. Further it is said, that the remoter the place, from whence the fire must fetch and draw the air, the better the fire will burn and increase to an intense heat. Therefore some have their wind furnaces contrived in such a manner, that the ash-hole shall be closely shut by a door on purpose, and at the side under the grates, and have introduced a long pipe in form of a trumpet, and its narrow end to it, and the other and wider end through the wall of the laboratory in the open air, that the fire might fetch the air, and draw it from afar of and without doors; and finding benefit and advantage, then the opinion was confirmed, and it is now commonly believed and said, that the fire doth fetch and draw the air unto it, though no body can discover any organs and instruments by which the fire performs these actions; nor declare the way and method of that drawing and fetching; but hearing the noise of the draught, and seeing the increase of the fire, they think it is wholly unnecessary, to make any further inquiry about a thing appearing too clear and manifest to the external senses; being the common conveyances of truths to the internal senses. Very few will believe, *sensus fallunt*, and know any thing of the rules and conditions, by which we can trust the external senses without deceiving the internals; else it would have been discovered a long time ago, that the draught of fire must be conceived, explained and understood otherwise than it hath been believed hitherto.

For it is an universal truth, as well as also a common knowledge, that the fire cannot burn and flame without air; and it is suffocated directly, even so as that no animal can live, grow and subsist, without air but it must perish and die inevitably. No one should here over-hurry himself and conclude, that the air did make the burning and flaming of the fire, and keep the animals living, else he himself will make his eyes cloudy and very dim for any sight through the veil, and of the things behind it secreted. For we find by experience, that all air as air will not be sufficient for the said great effects, but that here is required a certain constitution and qualification of the air. If the air rushes over a heap of burning coals before it touches the fire in a wind furnace, it doth prove very disadvantageous and fatal. And will then any one say, that the air coming out of one wind-furnace, would also serve immediately for a second and third one? Or the air expired by one animal, was fit still for the immediate inspiring of another, and the third also? And also why, or not? Some have supposed the wind and blast rushing with an hissing noise out of the æolopili, fit for increasing the fire to an intense heat; but the experiment shewed the contrary, and the fire was put out intirely. Little animals, as a mouse, bird, and small fish, when put in a roomy glass vessel, and this closely stopt, that the outward air hath no communication, soon grow sick, vomit and die. Though at first the vessel is roomy and full of air, yet it becomes soon unfit for keeping animals alive. If a company of people are confined in a close and narrow room, and all are very easy and content in the beginning, yet in a little time they become uneasy, anxious and sweating, and feel that they want something, and yet they neither know, nor can tell what: by and by one and the other swoons away, and when carried into the open air, they recover quickly, and come again to themselves, and don't know nor can tell, what happened to them. And the like accidents
happen

happen very often in small churches, when over-crowded with people. We have several examples, that a single man hath been lock'd up in a close box and carried abroad; and though there was air enough in the box, it being so roomy that four persons could lie in it commodiously, nevertheless he was found dead in half an hour's time. And that every one may convince himself thereof, he may take a large glass-bottle or receiver, containing one or two gallons of air, having a wide mouth, and put it close to his mouth, and try how often he is able to breathe out and in: indeed he will very soon feel, that the air is not fit to breathe in. On which it is evident, that air alone is not sufficient for that great effect, but that there must be some other thing in the air hidden and secreted, whereof that grand effect does proceed and depend, as from its proper and sole cause; and when the air is thereof deprived and exhausted, and not constantly supplied therewith from above, from whence comes every good and every perfect gift, then the air is good for nothing to the said grand effects.

No one ought to account this as fancies and whims, but should believe, that herein lies very great and uncommon truths, known to very few. And whereas the authority and witness of great and learned men, especially of our own native country, hath commonly a very great and mighty power and influence upon human knowledge and belief, and often more than all demonstrations and arguments, I therefore refer the reader to the new Royal and universal Dictionary of Arts, Sciences, and human Knowledge, and to read the whole title of air; whereof I will set down here only, what is most conducive for my present purpose, which is as follows:

“ Before we leave the examination of the various bodies contained in the air, we must consider that quality of it, which renders it salutary, and necessary to the life of animals and vegetables: (I would even wish not to have minerals excluded, they being equally the work of
God

God as the others) " a quality which has been not yet accounted for from any property of the air : but by *diligent inquiry*, however, we may possibly hereafter come at the knowledge thereof. Whether this latent virtue of the air is actually drawn out of it by animals and vegetables and minerals, and hence in a short time exhausted and consumed ; and whether when it does thus fail, the animal dies, nobody is, we think, at present able to determine. This however is certain, that if a small bird is put into a large receiver full of common cold air, and then the receiver very closely stopped, the bird will grow sick and vomit within a quarter of an hour, and die in the space of half an hour after."

Boyle of the air 184. A fish kept in water well closed, without renewing the air, dies in a short time. Fish die likewise in ponds, which are every where frozen, and quickly perish in water, out of which the air is exhausted, Hist. de l'Acad. Roy. des Scien. 1699, 240, 1701, 46, and Membr. 224. Flame and a red hot coal go out quickly in air close pent up. The little eggs of any insect whatsoever, being accurately stopped up in glass vessels do not produce their young, though assisted by a kindly warmth. The seeds of plants duly moistened and sowed in the best earth in close glasses do not grow, nor give any signs of life, though excited by a due degree of heat. On the other hand, the upper surface of the blood, which is exposed to the air, is of a bright scarlet colour, whilst in every other part, which the air does not come at, it grows as black as the blood of the cuttle-fish ; and yet as soon as ever this black part is exposed to the air, the black colour is immediately changed again into scarlet. These experiments demonstrate, that there is in the air a certain virtue absolutely necessary to animal and vegetable life.

I must beg pardon for adding here also the mineral life, whereof hath been given exceedingly clear witness a little before,

And

And the residence of these metallic particles in the air, seems to be owing to that surprising phenomenon, which in all ages hath been observed by miners, viz. that the fossil glebes, when dug out of earth, and exposed to the air, are affected by it in a very extraordinary manner. How frequently is it seen, that marcasites, pyrites, vitriolic stones, and metallic substances, that are quite exhausted, are so acted upon by the air, that they increase, come to maturation, are changed, renewed, and afresh impregnated, and become again enriched with a true metallic matter.

This latter is true and witnessed by experience, and cannot be denied but by the ignorant. The first remaineth only in question, by what power do quite exhausted metallic substances increase and come to a due maturation, and are changed, renewed, afresh impregnated, and again enriched with a true metallic matter? Can this be an effect of simple air? Or of the metallic matters residing and floating in the air? Are they not all dead atoms, having lost their native colour as well as their radical moisture, and in their resolutions into their first principles, and consequently wholly unfit for any impregnation, maturation, growing and increasing to a true metallic matter, and this even so small, as the animal particles residing and floating likewise in the air, and in far greater plenty, may be accounted fit for any impregnation, maturation, and producing of any living animal. Therefore let us remain firmly by that true principle discovered before, and called a certain virtue, and hereafter a vivifying principle in the air, absolutely necessary to animal and vegetable (and only add) and mineral life: and this life doth also comprehend and include the nourishment, growing, increasing and multiplication of every creature that is found in the animal, vegetable and mineral realm of nature. But the most remarkable is, when the above gentlemen compilers write thus:

“ This vivifying principle of the air, so very necessary

ecessary to the support of fire and flame, as well as animal and vegetable (and mineral) life, seems by every phenomenon to be the universal acid: let it be called as it will. *In verbis fumus faciles, si modo in re conveniamus*: distributed through the intire atmosphere, in a certain proportion, so that no portion of air seems to be without it."

By reading these words, I was highly amazed as well as greatly rejoiced: because, though I had experiments and witnesses enough, that that vivifying principle in the air was absolutely necessary to the animal, vegetable and mineral life; and also the very first beginning, nourishment, conservation, and multiplication thereof, yet I never heard nor read one witness so fully conforming to my ideas, that that vivifying principle in the air was even necessary to fire and flame, and to the support thereof. And therefore I have always carefully avoided, to let transpire one word thereabout; being afraid, that every one would think, that I was beside myself, and much learning had made me mad; and that no one would believe, that I did speak the words of truth and soberness. But finding that those gentlemen had the same ideas with me, I became encouraged to publish the present essay about the draught of fire, which else I should never have done.

Every one will now become curious and inquire, what is that thing or vivifying principle hid in the air? Surely the most part of mankind are wholly ignorant of it! Very few have been so happy as to obtain a sight behind the veil, and come to the knowledge thereof; and according to the different notions, whereby they had discovered and considered it: they also gave unto it several denominations, which are very significant and remarkable; and amongst them all is truly the first, and of divine authority, when it is called. 1. The light, the first creature produced out of the chaos, when God, Gen. i. 3, 4, did say: *Let there be light, and there was light, and God saw the light, that it was good!*

And God divided the light from the darknefs! Which was the work of the first day of the great Creation. How worthy that light is in the sight of God may be clearly observed; for God himself uses it as a type and similitude, revealing his incomprehensible being; when the holy scriptures do say, *God is light, and in him is no darknefs.* Light is his garment. God dwells in a light, to which no mortal man can come. And St. John says, of the Son of God, *In him was the life, and the life was the light of men*: that was the true light, which lighteth every man that cometh into the world. These all are metaphorical descriptions, speaking of the uncreated light and life of our souls, under the similitude and words of the created light and life of our bodies, and of all the creatures in the whole world. Every one can search into the *tertia comparationis* between both, which will show and discover more then can be said of it.

2. Anima mundi, the soul of the world; the spirit of the world; Archæus, the head, governor and director of the world, and all things therein. How this shall be understood, is explained by the ancients in these verses,

*Principium motus, cunctarum operatio rerum
Est anima, absque illa crescit in orbe nihil.
Quod vult illa tamen tanquam Domina omnibus horis,
Exequitur prompto corpus id officio.*

That it to say; The beginning, the motion, and the operation in all things is the soul, without which is nothing in the world. What the soul as the master doth demand, that will also the body as a dutiful servant execute.

3. Phlogiston, inflammabile, fire, synonyma of the light above.

4. Sulphur

4. Sulphur, salt and mercury, the natural and created Trinity in a perfect Unity.

5. The native calor and radical humidity in all creatures in the world, without which is no life, but death.

6. The vivifying principle; the universal acid, the sweet alcali or Salt of Nature; the universal Mercury; the Mercury of Philosophers, and so on. But there is one name more, which is worth to be remembered, viz.

7. Vagum fossil, vagabond fossils; this name at the first sight will raise a laughter, as well as a mousetrap of flesh or leather; and yet both is true, when rightly considered and understood. The author thereof hath been a wise man, who would thereby shew to the ignorant, where the proper springs and fountains of all minerals and metals do arise, not below and in the depth, but above, from whence do proceed every good, and every perfect gift, by that vivifying principle in the air, which in regard to the mineral realm is here called vagum fossil; and also in regard to the vegetable realm, may be called vagum vegetable; and in regard to the animal realm, vagum animale.

8. But all these different names in sound, may be by their true signification, very compendiously comprehended under the one only name Natura, which also is solely meant by those already mentioned; and also by all the other almost innumerable denominations.

Having shewed the principal names, I will communicate some memorable descriptions: the famous and very ingenious Dr. Becher hath described it thus saying:

“So true as the sun doth stand and shine on the heaven, even so true is this, that that living or universal spirit is the fountain and principle of all life and generation! That is that spirit, which dwells in the air, makes living all insects upon earth, doth ferment the water in rivers, moves and colours the blood in the veins, produces the metals in mines, sprouts out in vegetables,

getables, and grows to blossoms and fruits ! It is the all in all of the world. In the clouds it thunders, rains and snows ; upon earth it is greening, blossoming and fruit-bringing : in animals it causes living, altering and digesting : in minerals it makes smoaking, altering, fixing ; and if it is applied by art, it conserves the life, cures all sicknesses, and changes the metals. It is volatile in volatile things, and in fixt things it is fixt, nay the most fixt and permanent thing. In vegetables it is vegetable, in animals it is animal, in minerals it is mineral. It is the Chamælon of the philosophers ! But amongst all the things in the whole world, it is of the most perfect property, of the most penetrating essence, and of the most thin and subtil substance.

And the famous Dr. Cunad has described it per prosopoeiam thus, writing,

*Mater rerum materia est benedicta Sophorum.
Sum alma igitur mater, sum sicuti spongia prægnans,
Ad vivum almus ager, venosa, porosa propago.
Fons per se riguus, Phœnix, et Adamica virgo.
Venter venti, Naturæ locus, omniparensque,
Et conservatrix, et rebus in mundo novatrix,
Nullibi quæ non sementat, petulatur, olefcit,
Spermatizat, prægnat, foetat, sobolefcit, alefcit,
Et tamen Eugio nullomodo naufragat unquam.*

That is to say : The mother of all things, is the blessed matter of the wise. I therefore am a very good mother ; I am like a full and swelled sponge ; for all living things the best support, though a poisoning and porous growth, I am the fountain flowing by itself ; the Phœnix and adamical virgin ; the belly of the wind, and the house of nature ; I am the father of all things, and their keeper and novator. I sow every where ! I make growing, oil-giving and seed bringing ; I make pregnant, I give fruits, I give young ; I also suck

suck and feed them! And yet my maidenhead doth never suffer a shipwreck.

Therefore the famous Sendivog. writes very significant, and says, "In the air is a secret food of life, without which nothing can live and subsist!" Indeed, all the three realms of animals, vegetables and minerals are supported, nourished, and grow, live, increase and multiply by that vivifying principle, or secret food of life, hidden in the air. But in a very different way and manner. All the animals by breathing. The laws of their existence, and inevitable necessity oblige them to inspire and expire the air, be it what it will, in so much, that all the assistance of art and skill are in vain, and all that is done for them in the common course of nature fruitless, if they are deprived of the benefit of air, and the vivifying principle therein. Therefore the most wise and benevolent Creator hath given to them the most suitable organs and instruments for breathing. The anatomy of them must set every beholder in admiration and surprize, and also show to him silently, yet palpable enough, that they were made not solely for blowing the air out and in, but for all higher intents and purposes. The strongest veins are laid between the said organs of breathing for keeping them always very warm. The cold air inspired, fills all the innumerable small bladders and little globes full at once, and the air divided in such minute parts grows instantly warm. All warmth expands the air, which then requires a larger room: which being opposed by the skin of the small globes, causes a pressing; the gross air finding no way through them, the pressing increases, and the thinnest and subtilest parts, to wit, the vivifying principle in the air, doth transude and pierce through the tender inclosures, and then the remaining gross air is expired, and inspired another fresh portion of air, and so further. The transfused most tenderest part of air, or that vivifying principle and secret food of life, doth then mix and mingle itself with the blood, and is carried to the heart for the assimilation

milation and adoption into the essence and substance of the animal; whereof afterwards some parts are carried and mixt with the seed in the males, and this augmented to be a living seed, and in the females with the menstruum, and this thereby increased to be a living one: the other parts are carried into the stomach, wherein they are mixt with the victuals, and cause their digestion, and change them, and they themselves with them into a chyle, and lastly into the blood, which then carries to all the members their necessary support.

If this had been left to the care and observation of the animals themselves, it would have been forgotten and sometimes neglected, most certainly in the night and sleep; and then the whole realm of animals would have been nothing but dead carcasses the next morning. God foreseeing that great fatality, was moved to augment his mercy and grace, by imposing the absolute necessity of continually breathing; that it is made now unavoidable, that it cannot be neglected nor intermitted, neither in the day, or in the night, or in sleep, but must continually feed, and nourish the animal spirits as well as the whole body, with that vivifying principle, or secret food of life, hidden in the air. Hereby may be also further considered, why we are obliged to breathe more oftener, and quicker, when our passions, particularly of anger and love, are highly moved and raised? And that all our passions do principally depend on the animal spirits, which then want more nourishment, and like a little flame, which, when the cotton is opened, increases, and wants then more oil. Therefore we are forced to breathe oftner, quicker and stronger for the support of the spirits, which cannot be content with the victuals in the stomach, nor those fit for nourishing our spirits, nor those to support our passions; but that vivifying principle and secret food of life, hidden in the air, is the proper oil, nourishing our animal spirits, passions, and the
body

body too, that the flame of life may burn, and may not go out and vanish.

On the contrary, all the vegetables and minerals are supported and provided with that vivifying principle and secret food of life, hidden in the air by the pressure in the smallest and most minute pores: for they have no organs and instruments for breathing, and must be absolutely undone and perish, if God, the most wise Creator, had not given to the air, that pressing quality and power into every empty place and vacuum, to carry thither that secret food of life and vivifying principle, being absolutely necessary for the conservation and multiplication of all the creatures, whether animate or inanimate.

But who is able to count all the millions of the creatures in the three realms of animals, vegetables and minerals, which do yearly, quarterly, monthly, weekly, daily, hourly, and every minute and moment feed upon that vivifying principle hidden in the air! Is it not the greatest wonder, that it is not consumed, and does not fail, but is always sufficient, nay plentifully abounds to supply every creature? In consideration of which Dr. Cunad amazingly exclaims,

*Ipsa fui nutrix, et semper alumma sibi!
Hunc alit aeterni vena liquoris avem.*

That is to say, It is always its own nurse, and to itself the nourishment too. Indeed it is fed out of the fountain of eternal waters.

If any one will know something more of that fountain, he must inquire about the origin, nature and quality of the four elements, and their convenience and inconvenience, and then further into their actions and conversions; whereby are produced the first superior three principles, which by their circulation, adhesion and copulation, do produce two, and these two one, being that fountain. For it is undeniable.

Per

*Per Chaos antiquum res mundi semper eadem
Sunt, fuerunt, et erunt : Nil enim in orbe novum est.*

It is highly to be wondered at, that it is so very much unknown to the most part of mankind, though they use it daily, and no body can live and subsist one minute without it. But it can only be discovered and understood by abstracted considerations, daily observations, and diligent searches, but cannot be seen with common eyes, nor touched with common hands, though it is to the right and left, before us and behind, above and below us. All lay on, and suck daily the full breast of our mother nature, but they have no more knowledge and understanding thereof, than the new-born children of the milk and breasts of their mother, and would never find them, if they were not put in their mouths.

And that we may be made more attentive and heedful, let us go to the book of truth, which properly is inspired for the life of our souls ; nevertheless, we can be very sure, that when God doth speak therein of natural things belonging to this world, and the natural life of the things in the world, that he as the wise maker of them all, must know the best, by what form of words he can express himself thereabout, in the most proper manner. First let us well consider, what we do read, Acts xvii. 24, 25. God that made the world and all things therein giveth to all live and breath, and all things. Here are life and breath co-relatives, the one cannot be without the other ; the life not without breath, and the breath not without life, and both God gives, who made the world and all things therein, and could also give both immediately, but it doth please him to give both mediately by that vivifying principle or secret food of life hidden in the air. Secondly, let us well observe what is said, psalm civ. 29. 30. *Thou, O Lord, takest away their breath: (not bread, but breath) they die, and return to their dust. Thou sendest forth thy spirit, they are created; and thou renewest*

newest the face of the earth. But more emphatically is spoken thereof, Deut. viii. 3. *Where Moses said to the children of Israel: God fed thee with manna, which thou knewest not, neither did thy fathers know, that he might make thee know, that man did not live by bread only, but by every word, that proceedeth out of the mouth of God doth man live.* Here is attentively to be observed, that Moses doth not say which manna thou never *eatest*, nor thy fathers; but very considerately God fed thee with manna, which thou *knewest* not, neither did thy fathers know, though they and you were fed therewith from the very first day, till the last of life, but invisibly, which God hath made now visible, and you call manna, that he might make thee know, that man doth not live by bread only, but by every word, that proceedeth out of the mouth of God. Which truth is repeated and confirmed by our blessed Redeemer. Mat. iv. 4. and the devil himself did not dare to oppose the least word. And St. Paul, Heb. i. 3. *The Son of God upholds all things by the word of his power.* Can now any thing or creature be excepted?

When God himself speaks of it so very honourable and emphatically, shall not we become attentive, and deeply consider, what is said and spoken, and what God will give us to understand and know? Can then our gross ignorance make us so impudent, to call and reject it as fancies, dreams and whims, for no other reason, but for want of understanding and experienced senses? Shall we not then deserve the ignominious title of ungrateful, depraved, and wholly corrupted children, which God by the mouth of Isaiah, chap. i. 3. doth severely reproach, saying, *The ox knoweth his owner, and the ass his master's crib, but Israel doth not know; my people doth not consider!*

One word more. The whole paradise is wholly lost and every thing therein. Nothing thereof is left in the world, or to the world, but only this precious remnant, that vivifying principle and secret food of life, hidden in the air. Therefore the philosophers

have very significantly called it the *paradise bird*, having wings but no legs; and on that account never at rest, but continually flying day and night; and if it were to set down once, it could not stand up again, and fly any further. Indeed, it is so, and no otherwise: for setting down once, and coming upon, or in any creature whatsoever, it is immediately adopted and assimilated to the nourishment, substance, essence, increase and multiplication of the said creature, and cannot fly more. Some have by mistake searched throughout the whole ornithology, and meeting one conforming to their opinions, they did cry out *ὄρα*! but it was a great mistake. He is an hieroglyphic bird of the philosophers, like the Phœnix resurging out of his ashes, and the Pelican feeding his young ones with his own blood, whence we must not pick up the barren words, but only the meaning thereof.

We all are boarders at the table of God, and his guests every day. The first and principal plate is that vivifying principle and secret food of life. No distinction of age, dignity, quality, highness, lowness or poverty, but all like: *omnes ex eodem luto*! All of one dust of the ground! All at one table! All of one bread! That invisible manna! No distinction! And though one might collect more than the other, nevertheless it will be for every head no more but a gomer, the measure of the covenant, just enough for his life and subsistence. No necessity for lying up any store, or to be sorry thereabout for to-morrow; for this table of God is daily dressed anew, and at every hour from the morning till the evening, and likewise thro' all the night, and every one is welcome, and the least worm is not despised and turned off; for God hath mercy upon all the works of his almighty hands. No merchandize or traffic is permitted! It is no where to be sold or bought, neither at the first nor second hand! For it does by no means admit to be seen, felt, tasted, smelled or heard; nor to be measured by ells, yards, feet and inches; nor by bushels, pecks, gallons, pints
and

and cubic inches; nor to be weighed by troy or avoirdupois, pounds, ounces, drachms, penny weights and grains; nor to be accounted by any arithmetical rule; nay the sublime Algebra itself must stop here, and acknowledge its insufficiency. No monopolizing is possible, what would else become of the poor, they all must starve. All the necessaries of life of the second class have been burdened with taxes, excise, tolls and duties, and made very dear; but this of the first class is left free to every one, and it is to be had every where for nothing! No doubt, that it will be so always! Because, *de ignotis non judicat ecclesia*, that is to say, the clergy will never call for tithes from things, which they are wholly ignorant of.

The most famous physicians have been much puzzled about investigating the ferment and menstruum in the stomach of animals, and at last confessed, that it was an entire peculiar one, and impossible to be counterfeited by any human skill and art. They have told us the truth! Indeed: but do we now know more than before? Surely, it is most marvellous and very surprising! Mankind fill their stomach with almost innumerable kinds of different victuals, and often very contrary one to the other; cows, horses, sheep and goats, with grass, hay and straw; dogs, wolves, and lions, with bones and raw flesh; the ostriches swallow pieces of iron; and yet they all do digest their victuals, the pure is separated from the impure; the pure is changed in the essential substance of each and every animal, and this without their will and voluntary concurrence and co-operation; but solely by the virtue of that ferment and menstruum operating, directing and perfecting it all by itself alone: and lastly the impure is rejected and discharged as useless excrements, being changed differently in substance, colour, form and smell, according to the specific kind of each and every animal. What a great and powerful menstruum and dissolvent must this be! Is it not worth to be inquired after, till it is found out and known? I will deal honestly

nestly and say, If any one will tell me, by what ferment and dissolvent the fire doth digest and consume soft and hard, and the hardest wood, pit and candle coals, turf and all inflammable matters, and changes the pure into fire and flame, and the impure into excrementitious ashes; then I will tell him, that the one is as marvellous as the other, and yet both one and the same thing. The undeniable proof is this. Let all the forementioned kind of animals fill their stomach with their proper and convenient food, and then depart from the air, or that vivifying principle and secret food of life hidden in the air, then all digestion, separation of the pure from the impure, all motion, all circulation, and the life itself is immediately stopt, done and gone! Take also from a heap of fire and flame the free access of air, or to speak clearer, that vivifying principle and secret food of its life contained in the air, there all fire, burning and flaming, all digesting and consuming of the fuel, and the turning of the pure into flame, and the impure into ashes is directly stopt, done and gone. Nay a charcoal which is by the fire quickly devoured, easily digested, and the pure departed from the impure, and this last into a small bit of ashes; but being put in a crucible, and then covered, well luted, dried, and set in a strong fire, and constantly kept red hot for some hours, days, weeks, months or years, it will not be burnt or consumed, but the crucible being taken out, cooled and opened, the charcoal will be found intire, and in the same state as it was at first, when put in. This shows clear and evident, what is the great dissolvent and universal ferment, menstruum, nourishment, increase and life of all things, both of animals, vegetables and minerals, whatsoever.

One word more in regard of vegetables. Ignorant farmers only fancy, that their dung-cart alone bring them a plentiful harvest of corn. Is there then any reason for dreaming, that corn may grow out of the excrements of cattle, and the fine wheaten meal out
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of nasty dirt? *quae te dementia coepit!* Indeed, it is otherwise, and the process therein above the capacity and understanding of common people. For the discovery of the true ground of knowledge and understanding herein, I will only alledge two witnesses. The first is the philosopher Pennatus, writing,

“ This vivifying principle is in all things, and pierces through all things in the whole world, and it is a vivifying, substantial and essential spirit, giving to all creatures in the world their substance, essence, and life, and in that spirit they are, live, grow and move, and all things are full of its virtue, and nothing is void of its essence and power.

The second is the wise philosopher Hermes writing,

“ This vivifying principle is an heavenly one, and a true secret, and the life of every thing, and every man does want it. And this is the water, which in the wheat is the fine flour, in the olives the sweet oil, and in the peaches the delicious juice, and the fruit on all trees, and the principle of the generation and multiplication of men, and out of it is all which hath life. Itself doth never die: for it is the head of the world; that is to say, an humor, I say an humor, wherein all the sulphurous, saline and fiery influences of all the heavenly bodies and asterisms are united by the bond of the most subtilest terrestreity unto a sweet viscosity, and every where to be met with.”

It is not the child, but the mother nature herself, and without the knowledge and acquaintance of, and with her, cannot be obtained a true understanding of nature's works, methods and proceedings in the conservation and multiplication of animals, vegetables and minerals, and far less can be found the door leading into the garden of the Hesperides. Will any one say, that I do make more of it than is its due, and almost deify it? Then I must answer with a certain philosopher,

losopher, writing thereon, *per profopoeiam*, and saying,

*E'ns sum, quod genero, non vestra scientia facit,
Sint licet in gremio pricipia cuncta meo.
Scilicet est in me supremi gratia Jovae,
Isthaec qua perme singula sola facit.*

That is to say, I am a created being, and what I do engender and produce, that doth not depend and proceed from your science and ingenuity! And though also in my center doth lie the principles of all things: yet it is the will, grace and pleasure of the Most High Jehovah, that doth effect and produce all things through me.

We all are bound to the utmost obligation and gratitude towards the most wise Creator for that vivifying principle hidden in the air, which he has made and appointed to be the medium in the continuation of the second and daily creation, conservation and multiplication of all created things; and prescribed, nay impressed into it certain absolute laws and rules for acting and proceeding accordingly. It is that which made the very first point of our existence. It is that which drew and disposed the first lines of all our parts and members in miniature, and form of the tenderest white cotton thread, and the extent successively in length and thickness. It is that which gave us life in the dark prisons, as soon as we were capable of receiving and keeping it. It is that which drew us out of the dark prison unto the light of the world. It is that which learned us the art of breathing, when we knew nothing thereof, nor understood what it was. It is that which did learn us (by a sublime inspiration) the art of sucking the breasts of our mothers, without knowing them, or what we did. It is that which mixed the tender food with itself, and perfected the digestion and distribution to all our tender members for their growing and increase, without our own concurrence

currence and co-operation. It is that which calls us to our breakfast, dinner and supper, and must season all our victuals, when they have taste and relish. It is that which calls us in the evening to bed, and lulls us into a refreshing sleep, and awakens us again in the morning. And all this without our voluntary concurrence and co-operation, but solely by a natural instinct, as it is called, and properly the sole effect from our mother nature, and she the proper and sole cause of that natural instinct: she is, moreover, our best surgeon, apothecary and physician, and without her all the others are good for nothing; nay, she is the architect of the whole world, and particularly to the human body. All physicians are her scholars, and through her created to solid doctors. Whoever do not know her, nor are acquainted with her, are quacks and mountebanks. All medicinal virtues of drugs, collected in the realms of animals, vegetables and minerals, do depend and proceed from her alone. All nostrums without her prescription and direction are poisons. And when she will not cure our body, then all physicians in the whole world, and all nostrums are good for nothing. The course of all sickness, the crisis therein, and the cure of the whole doth solely depend on her. If she is assisted and helped by medicines proceeding from herself, or very near kindred to her, and prepared to her will and liking, she is pleased, *similis simili gaudet*, loves like, she becomes delighted and strengthened, the morbid matter is attacked and expelled, the cure succeeds well, the recovery follows. But if the medicines are strange, or contrary, or applied at undue time, she grows angry and hot, the whole machine trembles and comes wholly out of order, the sickness and evils increase and terminate in death, death, death! the end of all things in the world. Hereafter she is busy for resolving the whole remainder successively to an handful of dust, which is what it was in the beginning, conformable to the severe sentence
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of the supreme Judge, *Dust thou art, and unto dust shalt thou return.*

But enough of that; I will now proceed to my particular and proper purpose of explaining and demonstrating the true and proper conceit and idea of the draught of fire in furnaces, flues and chimnies. The fire is not the least amongst the excellent and marvellous creatures of the most high, wise and almighty Creator of this world. But it cannot live, operate and subsist, nor consume, digest, and change the fuel into fire, flame and ashes, without the access of air, or more properly, without the vivifying principle or secret food of life, hidden in the air. Yet it has neither organs for breathing, nor hands for fetching, nor a cart for drawing it. Those defects are supplied by the pressure of the air. The process is thus. The fire being kindled, receives its first life from that vivifying principle hidden in the circumambient air. For in a receiver exhausted of air, neither flint nor steel will give one spark of fire; nor gunpowder take any fire. Therefore it is evident, that the life of fire doth depend on the vivifying virtue in the air. As soon as it has received its life it begins to attack the fuel, and digest and resolve it, and change the pure into fire and flame, and the impure into excrementitious ashes; and in those actions the air is expanded, rarified and much attenuated; and consequently there does exist an emptiness and *quasi vacuum* for the denser and grosser outward air, which by its pressing quality forces into, and finding no other way but through the grates and burning fuel, forces through, and carries with it to the fire more of its vivifying principle, or secret food of life; and the more the fire is therewith nourished, the more it doth increase, and the more fuel is consumed and digested; the pure changed into fire and flame, and the impure into ashes, whereby the air, fire, flame, and smoke are far more expanded and rarified, that then the denser outward air forces more strongly through the grates and burning fuel, and nourishes the fire; and

and thus continuing, the fire is constantly fed with that vivifying principle in the air, and the remainder rarefied, and with fire, flame, and smoke, expanded and attenuated; from whence arises also a constant occasion and proper cause for the denser outward air to push and press through the grates and burning fuel, &c. And this is the true conception and proper idea of the draught of fire in furnaces, flues and chimnies.

From what has been said I would wish that no one would judge unreasonable, and think that I disapprove and would change the words of common use, and introduce a new manner of speaking about things. Indeed I have no business with shells, my care is solely for the kernel, whether it is pinched by a worm, or good and whole. I have no concern about words, but with the ideas and understanding of words in common use. We are absolutely obliged to speak with the vulgar, or else they could not understand us: but we should not think with the vulgar, nor should our ideas and conceits be vulgar. We must speak with the vulgar, that the sun, moon and stars do rise and set, though we know, that it doth solely proceed from the globe of the earth turning about its axes once in twenty-four hours. We must speak with the vulgar, and say, The new moon, the first quarter, the full moon, and the last quarter, and nevertheless know, that it doth solely depend on the appearance to our eyes, as nothing thereof is to be found in the moon itself; the half part of which towards the sun is always light, and the opposite half part dark. Thus we must speak with the vulgar of the draught of fire: the fire doth draw and fetch the air, and yet have other ideas and conceptions thereabout than the vulgar have. *Loquamur cum vulgo, sed sentiamus cum eruditis.*

From the above may now be easily discovered and understood, the way and manner of procuring a strong draught in any furnace; and the proportionable measure of the grates and fire place; and

also of the sufficient extent and room for the rarefaction and expansion of the air, fire, flame, and smoke; and out of this a well proportioned flue, through which the rarefied and expanded air, in company with the fire, flame and smoke, may be neither stifled, nor hastened and overhurried, but decently and becomingly conducted, in a proportionable chimney, and into the great receiver of the atmosphere.

Moreover, in all smoke arising from any kind of fuel whatsoever, is always contained a great deal of inflammable matter, which hath not been kindled by the fire, and doth settle and lodge in the inside of the flues or chimnies, which is commonly called soot. If there was not a great deal of inflammable matter in it, then there could never be found a burning chimney with such furious flames, as is often the melancholy case; and a most frightful one, when the soot doth proceed from wood. Such unhappy accidents shew and prove evidently, that all soot doth contain a great deal of inflammable matter. But when every thing is well devised, and the fire hath a sufficient room and extent, being neither too narrow nor too wide, but even right, and enough for the necessary expansion and rarefaction of air, fire, flame and smoke; there the denser outward air presses the stronger through the grates and burning fuel, and is there constantly emptied from its vivifying principle, by which the fire is nourished and increased to an intense heat, and all the inflammable matter in the air, fuel and smoke is kindled and turned into fire and flame, filling the furnace, flue and chimney to the top, where no smoke comes out, but a clear flame; which is an evident sign, that the furnace, flue and chimney must be thoroughly filled with fire and flame. And in this case there will never be found any soot in the furnace, flue and chimney, but they will be always as clean as when they were new: consequently all the smoke and soot must have been wholly changed into fire and flame.

Therefore

Therefore I have in my new invention constructed a place for the fire and fuel, which I do call the first furnace, and out of which goes an opening into the second furnace. This proportionable-opening serves for the regulation of the body of fire and flame necessary for the intent and purpose. The second furnace having a competent extent, serves for the expansion and rarefaction of air, fire, flame and smoke, from whence they go one with the other in company into a well-proportioned flue, under and throughout the whole bottom of the boiler, touching the bottom every where in a way of above one hundred feet; and lastly, into a proportionable chimney, and from thence into the wide expanse. The before-mentioned expansion and rarefaction of air, fire, flame and smoke in the second furnace, is also a constant occasion and cause for the denser outward air to press into and fill that emptiness and quasivacuum; and finding no other access but through the grates and burning coals, it then pushes and presses through, and this is vulgarly called the draught. But then undergoing the same action of fire, by which the vivifying principle is not only exhausted and consumed, but also herewith the fire is nourished and increased to an intense heat, and the remaining air is more expanded and rarefied; then there doth exist a continual occasion and cause for the pressure of the denser outward air through the grates and burning coals; and the rarefied and attenuated air, in company with fire, flame and smoke, go easily through the serpentine flue, under the whole boiler, till it comes into the chimney, and lastly into the universal receiver of the wide atmosphere.

For the better understanding, and full conviction hereof, may be considered and a sight taken of a large furnace, wherein great quantities of ores are smelted. There is commonly observed, a very great and strong draught, with a sounding noise, resembling the noise of a large bellows in a smith's forge. This furnace hath two doors, one at the side, and the other over

against the fire place, and above the latter is the flue into the chimney; and in smelting ores both doors are closely shut. The burning fire emptying, attenuating and rarefying the air in the furnace, makes also room, emptiness and quasisvacuum, for the denser outward air, which having no easier way of coming into, but through the grates and burning fuel, there it presses and forces through with a sounding noise, and it is immediately exhausted and evacuated from its vivifying principle or secret food of life, wherewith the fire is nourished and increased to a living flame; and the other part of the air is rarefied and highly attenuated, and driven out into the flue and chimney, which gives new occasion and cause to the denser outward air to press and force through the grates and burning fuel, and thus is the constant process: and thereby is the fire continually nourished with the secret food of life, and strengthened for the consumption and digestion of the fuel; whence the pure is changed into fire and flame, and the impure into excrementitious ashes: whereof successively arises an intense heat, so that fire and flame fill the whole furnace, flue and chimney, even to the top. But as soon as one door is opened the draught is stopt and ceases immediately, the fire and flame do successively and quickly decrease and come to the lowest degree, and the fuel, before flaming, is reduced to the state of glowing coals. Doth not this evidently prove, that the fire doth not draw and fetch the air, or else it would not cease and leave off immediately when the door was opened? Doth not this evidently shew and prove, that the fuel of itself cannot give life, burning, and flaming to the fire? For the same quantity of fuel lies still upon the grates in the fire place, from which did ascend so much flame, filling the whole furnace, flue and chimney, but now lies there as in a swooning dying state: doth not this shew manifestly, that the fire and fuel want something, which hath been hitherto unknown, and very little thought of? A thing without which the
fire

fire cannot live and flame, even so little as for an animal to live and subsist therein, as hath been sufficiently demonstrated above. But as soon as the door is closely shut again, the denser outward air begins to press and force through the grates and coals, and carries thither with it the vivifying principle and necessary food of all life, and the fire therewith being nourished and strengthened becomes again living, digesting, consuming and turning the fuel and its pure parts into flame, filling the furnace and chimney, and the impure into excrementitious ashes. If this ocular experiment cannot open the eyes of men's understanding, then the gutta serena must be accounted incurable.

But he who hath well apprehended, what has been said, will be also enabled to judge rightly about the quantity of coals, which must lie upon the grates; and whether it is reasonable, to put only so much coals in the fire place, that they cover the grates about six, seven, or eight inches high, that the air may easy force through them; or whether more profitable and advantageous to throw in as much as the fire place can hold, as is often the case by ignorant workmen; especially, when they would rest some hours; whereby the air is too much hindered and stopt in its pressing through, and the fire not duly and sufficiently supplied with the absolute necessary food of life, and therefore reduced to a languishing state. And in like manner common people are possessed of the pre-conceived opinion, that eating and drinking is the nourishment and preservation of their lives, and therefore foolishly conclude, that the more they do fill the bellies, the more they must be nourished and strengthened; and never will let any one persuade them, that much food doth greatly hurt them; and far less, *quod natura paucis contenta*. Thus likewise common workmen are possessed of a similar pre-conceived opinion, that the fuel do make and nourish the fire, and the more fuel is put in, the better and greater must it increase, draw and fetch air, and be blown up. And to deliver such people from their

their prejudices, is more than an Herculan labour, and almost wholly impossible.

Before I wholly depart from the great smelting-furnace, I think, that very few gentlemen will be affronted, when I show and give them to consider, why the arch of almost all those furnaces is so much lowered and bent down, that between the arch and ore, is scarcely the height of five or six inches? I presume, that it is done with an intent of forcing the fire down next to the ore for obtaining a quicker smelting. The meaning is very good indeed, but the mark very badly hit. For it is manifestly to be seen, that the fire and flames are forced to hasten in a strait line over the ore, into the flue and chimney, scarcely touching the ground and ore, except by length of time and greater quantity of fuel. Moreover, there is also not left sufficient room for the expansion and rarefaction of air, flame and smoke; consequently the pressure of air, through the grates and burning coals, must be lessened, whereby the fire is deprived of its full nourishment with the most necessary food of its life, and its true vivifying principle.

On the contrary, I wish every one to consider whether a globular arch of a due extent, would not be of more benefit, when it is made in such a manner, that the fire and flame are forced to reverberate continually backwards, and meeting with new fire and flame coming into it, they must be doubled, and reverberating again and meeting with new flames, they must be fiercely strengthened for a quicker and stronger operation, than when they go in a strait line over the ore and metal away into the flue and chimney, like a water stream troubling and moving neither sand nor gravel, and lesser the ground and bottom. Moreover, an arch of the half part of a globe would have a better extent for the necessary expansion and rarefaction of the air, flame and smook, and thereby be obtained a stronger draught, by which the fire and flames must be made more lively and increase to an intenser heat, and thus
would

would be saved a good deal of time and fuel. Lastly, every one will also apprehend and understand, that the opening of such a smelting furnace into the flue and chimney, being in the beginning, when the fire is lighted narrow enough and scarcely sufficiently wide to carry off the first smoak, yet hereafter must be found and observed to be too wide, when the fire increases to its due degree, the furnace red hot, the air highly attenuated, and all the inflammable matter in the air, fuel and smoak turned in fire and flame, which now all together escape too quickly out of the furnace, and would be far better, if that opening into the flue could be made somewhat narrower. But no body, I know of, hath taken hitherto any notice thereof, and far less trouble themselves about finding out a method of regulating the flue in great smelting furnaces, that it could be made quickly and easily narrower or wider as occasion and necessity may require. No impossibility is in the way! Some few thoughts thereabout, and a little experience would make it very light. But I would sooner dare to stir in a nest of wasps and hornets, than to speak thereof one word in any smelting-house. Surely they would run upon me with one accord, and kick me out of doors with their iron bars and crows, with thousands of oaths and curses. But I will take always heed.

Having more than sufficiently explained the true ideas and conceptions of the draught of the fire in furnaces, flues and chimnies, and spoken of every thing in a very clear and intelligible manner, and proved also by undeniable experiments and universal experience, against which cannot be made neither exception nor opposition with any ground of truth and reason: nevertheless I do grant full liberty of approving or despising and rejecting the whole, or any part thereof, as may be thought proper, and I will in every case remain fully content, in the assurance, that truth will always defend itself.

But what connexion the present treatise hath with the

the brief account of my new invention, published some months ago, I will now show by a short description of all the experiments and trials made for its discovery.

The first and proper occasion for it, and all the following did arise from my furnace, which I have standing in a garret, and the whole made with my own hands without the assistance of any person. In this furnace I kept fire day and night, and could perform at one time more than sixty different chymical and philosophical operations, and processes in different vessels, and by a different degree of heat; and also boil and roast at every hour, and make breakfast, dinner and supper when I thought proper: and above all, I had the great convenience of having my room equally warm, both day and night, which was very agreeable in the winter season, especially in the morning coming out of bed; and the fire cost me weekly no more than four bushels of coals, which I bought at the next glass-house for 8d. which did last me one whole week. The furnace was filled once every day with a little more than half a bushel, and thus the firing cost me daily 1½d. This furnace several gentlemen have seen and are eye-witnesses: and I can show it still to any one, who is incredible. And then he will say perhaps, that it was a common knowledge and an invention of every gentleman, engineer, mason and bricklayer in England.

An account of this my furnace was accidentally carried to a certain gentleman, who devised a plausible occasion of seeing it, and made afterwards the proposal, whether an application thereof could not be made to salt-works, not only for saving coals, but also for procuring to the workmen time of rest and sleep in the night, without fear of losing the fire, and stopping the boiling and the work? I gave the promise of bringing it about by some few experiments, and he the promise of bearing all expences, and rewarding me for my time, work, and trouble, reasonably. Upon this

this reciprocal promise by mouth, the beginning was made.

The first setting out was upon the principle of keeping the fire in the centre of the water, which method I have been studying a long time. And though the furnaces for that purpose were exceeding skilfully contrived, particularly the last, that the sole remembrance thereof doth please me still : and also a certain gentleman, of great understanding and quick penetration, when he saw it, immediately said, that there any quantity of water must boil instantaneously ; and I also am firmly assured, that the most ingenuous gentlemen would have said the same, and some perhaps would have laid a hundred guineas to one ; nevertheless in trial and practice it was found otherwise, and the boiling obtained no sooner than in eleven hours. But then it was to such an excessive degree, that the water sprung up more than a foot above the surface ; and when all the coals were burnt, and the fire entirely out, yet the boiling continued about six hours longer. The boiler was from deals of 14 inch thick, and made by four carpenters in six days ; and upon it laid a cover of boards, out of which went a pipe, being about nine inches square, through the window into the air, for carrying out the steam as soon as it did rise. It was about half an hour after eleven o'clock at night when the water came to the boiling, and made such an excessive noise, that the gentleman became curious of seeing the water boil, and about twelve o'clock he took off part of the cover, and there rushed out such a quantity of strong steam, that the whole house was filled instantly, and all the locked rooms wherein the family were asleep, by which they were awakened, got up and came down, and the next morning all the walls of the house were dressed plentifully with dew, all the prints spoiled, and the furniture dropping wet. Though this may cause a laughter at first, yet if it is well considered, it will then shew to the wise a great deal more, whereof I do not chuse to say any thing further here :

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because

because that principle of putting the fire in the center of the water was laid wholly aside, being complicated with several difficulties and tedious accidents, and moreover, not well fitted for making salt.

Indeed, our mother nature is very hard and stiff-necked in observing the laws prescribed and imposed upon her by the hands of her most glorious Maker, and neither can nor will condescend to the fancies and whims of her children, but absolutely desires and insists upon, that they all must and shall accommodate themselves according to her will and demands. And if she was not so very capricious, her foolish children would have turned her into a common prostitute a long time ago: but now she is a pure virgin still. It doth often happen, that we make our dispositions, delineations and drawings very ingeniously and skilful; and by revising them we cannot but admire our own abilities, and assure ourselves of absolute success. We shew our projects and draughts to our friends and acquaintance, not for correcting, amending, and raising doubts, which would be an affront to be resented severely; but solely for gaining their full approbation, applause, and praise before hand. We go then to the practice and trial. Alas! The whole is contrary to the expectation! It will not do! There are so many difficulties which could not be foreseen, or thought of before! The spectators are departed! The place shut, and nailed up round about with boards, and left only a small door with the motto,

Porta patens esto nulli, claudaris honesto.

But we must not wholly despair, if the contents of the purse are not wholly spent. *Nocumenta, documenta!* What does us hurt at first, makes us wiser the second time! By missing the aim at first, we may be enabled to hit the mark the second or third time. Masters are not born! due knowledge, application and exercise doth create them.

There-

Therefore, I did also meditate upon another way, being more suitable for the intent and purposes; wherein I made the last four trials with some alterations; and therein found out the thing sought and wished for from the very first beginning. Of which trials and alterations therein I will now give a description as far as is reasonable, without betraying and hurting myself. For the memorandum of being in England is so very deeply impressed in my heart, and the manifold experience too, that almost every one doth persuade himself of having full liberty of kidnapping new inventions, and the authors too, and if it is not possible both, at least the first, and then endeavor to ruin the latter in every manner and way possible to be invented and brought about, that they might be made wholly unable to commence a suit. All things are very dear, but arts, sciences and knowledge very cheap, and of no price at all. Every one doth long, but will pay nothing for them; because the most part are ignorant of their worth and prime cost.

The boiler used in all the trials was made from sheet lead, and in length eight feet, in breadth four feet, and one foot deep, being counted large enough for our purposes. The first furnace and coal-magazine was made only so large as to contain at once 160 lb. of Staffordshire candle-coals, being enough for trial; and it was used also in all the subsequent trials without any alteration. The opening of this furnace into the second, by which is regulated the body of fire necessary for the intent and purpose, did likewise remain unaltered, and one and the same in all trials and experiments. The second furnace for the rarefying and expansion of air, fire, flame and smoke, did likewise remain one and the same in height, breadth and length, except that it was in the first covered, and in the latter uncovered. The quantity of 160 lb. of Staffordshire candle-coals lasted in full burning and flame four hours, and the second filled with 160 lb. a great while longer. But that this coal magazine can

be widened and enlarged, that it may hold at once from half a ton to a whole ton, and also the square form changed into a circular one, there is not the least doubt. We intended only to make trials for the discovery, for which our apparatus was sufficient.

The first trial was made thus: I composed six pipes for the flues, which I laid in a common room. The second furnace and all the six pipes or flues were free on all four sides round about, that the warmth and heat coming through, was collected in one common room, out of which could escape nothing; and upon that common room was set the pan. Then the pan was filled with water, the furnace with 160 lb. of coals, and the fire kindled: but there was no draught, because the pipes or flues were too narrow, though I thought before that they were wide enough, and they all were made in a proportionable number of square inches.

Therefore the pan was emptied and taken down, the pipes widened to a certain number of square inches, and then the leaden boiler set up again, filled with water, the furnace with 160 lb. of coals, and the fire lighted: there was an excellent draught, like the bellows in a smith's forge; and when the first furnace was burnt down, and filled again with 160 lb. of coals, then the fire and flames in a full body, according to the diameter of the pipes or flues, went into the chimney and came out at the top, that the people in the streets came into the house and said, Sir, your chimney doth burn. It was very happy that it was day and sunshine; for if it had been night the whole neighbourhood would have been alarmed. From this it became evident, that fire and flame must fill the second furnace, the whole serpentine flue, and the whole chimney, or else it would have been impossible that the fire could be seen in the day time at the top of the chimney, which was a way of above sixty feet, by 40 lb. of coals in one hour's burning.

This

This did show to me the true geometrical proportion betwixt the body of fire and flames, flues and chimnies; and also of the grates in a certain and definite number of square inches. In this trial the water came in nine hours to the boiling, that little blisters and bubbles did rise plentifully from the bottom of the water to the surface thereof, and consequently fully sufficient for salt boiling. Nevertheless the perfect and full boiling was not obtained in that time. Because the paving-stones, whereof the pipes and flues did consist, were mostly two inches thick, through which thickness of stones the fire and heat cannot penetrate so easily and quickly, but requires a longer time. And the boiling absolutely desired, and this also in the shortest time, and in one minute, when possible, and by the smallest quantity of coals the lesser the better: then I considered about another alteration, and therein upon a further inquiry for certifying the forementioned discovery. In the mean time I was brought to a small salt-work in town, where a saltpan was at work. I put my finger into it, and found that it was not hotter than bloodwarm, and could keep my finger therein a long time, and might have left it therein the whole day without any the least hurt; and lastly I did say, it is scarce warm! To this the workman answered, and said, O! the pan doth work very well! But the steam arising was extremely weak and thin, and scarcely to be seen and regarded. Hence I concluded, that the working of a saltpan did not even require boiling at all. And I do know certainly, that it is so in truth, and all strong boiling doth produce a weak salt, liable to a quick deliquescence in the air. This was the first time in all my life, that I came to a salt-work, and to a working saltpan, having never taken notice thereof, nor once imagined, that I should have any occasion for it in all my life, being so very much out of my way. But since I have discovered a great many and very notable things thereabout.

about. But at that time, and from seeing this my first saltpan, and for several bye intents I did contrive

The second trial, which was made thus; the pipes and flues were stoppt, except the first near the first furnace, and now called the second furnace, and the last next to the chimney, and the room between the flues filled out and made level, and then upon the level double bricks, one upon the other, and then upon them large square bricks, under which the fire and flames, coming by four different holes of different dimensions out of the second furnace, did go down into the last pipe and into the chimney. The leaden boiler was set down upon the squares, filled with water, the furnace with 160 lb. of coals, and the fire kindled. There the water was brought in eight hours very near to boiling, that the blisters and bubbles did rise in the greatest plenty from the bottom to the surface of the water; and also a very thick and strong steam, that we could not see nor observe the surface of the water, and this was also scalding hot throughout, and consequently fully sufficient; nay more than sufficient for making good and strong salt. But being absolutely desired, and insisted upon a perfect boiling, and this in the shortest time, then I did make

The third trial. The pan was emptied, taken down, the square bricks removed away, and then the leaden boiler set down again upon new rows of bricks, that the fire could touch the naked bottom of the boiler throughout, and then filled with water, the furnace with 160 lb. of coals, and the fire lighted, and then in one hour and half, the water did perfectly boil, and very strongly too. The steam rising was very thick and strong all over the surface; but it did boil more above next to the furnace, then below next to the chimney, which yet in a short time would have spread itself over and over the whole surface. But this was required in the shortest time. Therefore I made an alteration hereof in this manner.

The boiler was emptied, and taken down, and then made

made three flues, one downwards; the second upwards, and the third downwards again, and into the chimney. The measure of the flues was about twenty square inches less, and under the rule found out and discovered above, and this even not by random, but by particular design. Lastly, the boiler was set down again, filled with water, and the furnace with 160 lb. of coals, and the fire lighted, and there was no draught. I was greatly amazed, that such a small deficiency of twenty square inches could make the flues unprofitable and stop all the draught.

The boiler was obliged to be taken down again, and the flues made higher and wider, and according to my devices only twenty square inches above the measure discovered before; but the stiff-necked bricklayers have augmented it with twelve square inches more. Lastly the boiler was set down, filled with water, the furnace with coals, and the fire lighted; there was found a very strong draught, and in one hour and an half a perfect boiling, and a very strong one too, that the gentleman being always present, told me, that he never saw such a strong boiling in any salt-work. Yet the boiling was not observed equally throughout the whole surface, though from thence did arise a very thick and strong steam equally all over the whole surface, that the whole place was filled and darkened, though the window and door was wide open. And when the first furnace was burnt down, we were satisfied and went away; because the sole intent of that gentleman was only for salt-making, which now was obtained.

The next day the pan was taken up, and I accurately measured again every part, and found that the first and second flue were burnt wide throughout, and only the third flue black still; this did show evidently, that fire and flames had been fully therein, and if one furnace of coals should have been spent more, then the fire and flames would have gone into the the third flue and into the chimney, and caused a boiling over
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and over. And by farther considering I found, that when the flue is wider than is necessary, then the draught is too strong and quick, and the lighter parts do hasten too much, and leave the shorter and heavier behind; and thus the company is separated, and departed one from the other. But if the flue has a proportionable measure in regard to the grates, furnaces, and the body of fire, then the air, fire, flame, and smoke do travel becomingly, and in full company one with the other till the last exit. And whereas in that latter trial, the cleaning of the flues was somewhat difficult, then for amending it, and bringing to the due perfection and easy execution, was undertaken

The fourth and last trial; wherein the due and determined measures were accurately observed even to one square inch, and the serpentine flues also disposed for the most easy cleaning, opening and shutting, with very small trouble and no expence; and all parts were made in a full geometrical proportion of one with the other. Lastly the leaden boiler was set down, the furnace filled with 160 lb. of Staffordshire candle-coals, and the fire lighted. There was a perfect draught, neither too much nor too little, but quite right, and the water did perfectly boil in one hour and a quarter, and the steam did rise equally strong and thick all over the whole surface of the water, that we were not able to see any thing from the surface of the water; and when the coals were almost burnt down and the furnace filled again, there were observed also fire and flames in a full body, according to the diameter of the serpentine flue in height and breadth in the chimney, and by and by the boiling went all over the surface. The pan was uncovered, and every one will apprehend, what must happen, when the boiler is closely covered, as it is at the fire-engines. We were now satisfied and desired nothing more. And hereafter the whole was taken down, and every thing removed.

Moreover it is also to be remembered, that a tub full of cold water was set above the leaden boiler, and
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in the tub fixt a brass cock, through which did run 28 gallons of water in one hour. This was done with an intent of seeing whether the cold water would check the boiling: the cock was opened, the cold did run in, but the boiling constantly continued the same as before without stopping. And this gave me a sufficient occasion for applying some particular experiments for obtaining the boiling in a far shorter time, and also another advantage in salt-works, and making salt with better dispatch.

All the before-mentioned trials and described experiments were made in the presence of the gentleman, who first applied to me, and also furnished all the expences to each and every of them, and seen also all the effects mentioned; and if I had not told the truth, I must expect, that very soon would appear an advertisement in the News-papers, wherein I should be severely reprimanded and corrected as a liar and impostor upon the public. Which also would be right and his duty.

Nevertheless I will in all kindness possible excuse each and every one, who has seen nothing of the said forementioned experiments, when he is in doubt thereabout, and cannot believe, what is said thereof. Because, I myself should do the same, if I was not convinced thereof by all my senses, both external and internal. It is an intire new thing and almost inconceivable, how such a small quantity of coals can give such a quantity of fire and flames, filling out furnaces, flues and chimnies, in a way of fixty; nay, above 100 feet, and produce such great effects. But I beg it may be remembered, what hath always happened in the birth of the best discoveries in all ages. The first inventors of typography were accounted for witches, and their first books the works of the devil, and they were obliged to make haste to escape a dreadful inquisition. The first author publishing and demonstrating his problem of the existence of the antipodes, was declared for a dangerous heretic, and

condemned to the fire, and at last was forced to abjure that great heresy to save his life. Columbus was accounted a man of crack'd brains, when he spake of the existence of the fourth part of the world ; and also no better the prince, who furnished him with a ship : and if any one about four hundred years ago should have talked about the astonishing effects of gunpowder, bombs and cannons, he would have been accounted a mad man without all doubt : and now we are all convinced of the existence and truth of all the said things, that he, who would now doubt or deny them, would and must be again accounted a mad man. We mock also at the ignorance of the ancients ! But is the world wiser now ? Indeed, *ars non habet oserem nisi ignorantem*. Great many are in their imagination and self-conceit bigger then Æsop's frog, and the streets too narrow for their paths ; and having in their pockets one guinea more than others, they grow intolerable, and pretend, that Miss Pan sophy was their lawful wife, with the dower of all ability and authority of judging and deciding every question raised. They esteem solely their own children, and though these are broken and crooked, yet they shall absolutely be tall and strait ; and behold all others with envy, spite and contempt, and call them broken and crooked, though they are strait and tall like a cane. When they speak, all must be silent, and hearken to their sentiments and decisions as of oracles *ex tripode* ! We can but turn about and say ; *risum teneatis amici*. All such gentlemen could safely drink a full cup of water out of the Stygian river without the least fear of having any effect upon them.

Nevertheless, all the forementioned trials and experiments, being made by Staffordshire candle-coals, I must admit the reasonable question, whether also common pit coals, and other fuel would answer for the same purposes and effects ? To this I do answer in full honesty, that the furnaces and especially the coal magazine is solely fit for candle coals, coaks, chair-coals,

coals, and in some way for turf and cut pieces of wood, and not for any other fuel, which doth solder together in lumps; and then stop the falling down of the fuel above, and consequently hinder the constant feeding of the fire. But there must be another condition, and form of the first, as well as the second furnace, but not of the serpentine flue and chimney, but rather according to the latter, must be regulated, the dimension and measure of the first and second furnace, which is solely known to me. And by my great and manifold experience in furnaces and fire kept by common pit-coals, and by a particular reason of the constitution of the first furnace, I am firmly assured, and I do also assure others, that common pit-coals must have more effect and benefit, than Staffordshire candle-coals, in such and the like experiments as described above, and the sole difference doth consist therein, that the furnaces for candle-coals are filled once or twice in 24 hours; but the furnaces for common pit-coals, and other kinds of fuel must be fed successively, and from time to time, and like it has been must be done hitherto and every where, where the fire hath been kept with common pit-coals, and other the like fuel. Ingenuity and art can do no more, but discover the most beneficial and advantageous use of natural products; but to change them and their nature and substance according to the wish and will of men, is more and above all that can be reasonably desired and expected.

When all is duly considered, which I have advanced hitherto, and said about the draught of fire in furnaces, flues and chimnies, as well as of the trials and experiments made for the discovery of my new invention; then it must become evident and palpable, that it will be of the greatest benefit and advantage at the fire-engines, salt-works, distilleries, brew-houses, sugar-houses, or sugar-works, in the plantations abroad, and also in allum, copperas, Roman vitriol, saltpetre works, and refineries, and the like businesses. And how many excellent mines lay waste by reason of wa-

ter, and no body will undertake to help them with a convenient fire-engine, on account of the excessive expences of coals yearly wasted under the boilers. Indeed, in this my discovery is to be found more than can be seen in a superficial revision. It does open the door for the mastership and regimen of fire for all intents and purposes; and I am without all vain glory, the first in all the world standing now above five thousand years, that hath found out and discovered a geometrical proportion between grates, fire, flames, furnaces, flues and chimnies; and also clearly demonstrated the true ideas and conceptions of the draught of fire in furnaces, flues and chimnies. Improvements thereof will be very difficult and almost impossible; for it does contain already in itself the necessary perfection. But that it will admit several other useful and beneficial applications, is without all doubt: nay, it will give constant occasion for several new discoveries and inventions. To the proof of the latter I must return to my brief account, wherein, page 14 I have proposed my new boiler of 16 feet in length, 8 feet in breadth, and two feet and a half deep, in comparison with the old boiler described page 12. No body hath made to me any objection thereabout, and I am also not in need of any; for I myself have made all objections possible, which are all moved, except one, the lowness of the boiler being only two feet and an half, to which would be objected, that no man could get into and clean it from the filth, and crusts sticking at the bottom and sides. To amend this was at that time impossible to me: but considering thereabout continually day and night, my new invention did enable me to make another new invention of a boiler, solely fit for fire engines, which is from the bottom to the cover 5 feet high, and to be filled with water 3 feet deep, whereof the surface is the same with the before-mentioned old boiler of 108 square feet, and the contents 17 hogsheds of water, instead of 29 in the compared old boiler, and with the same benefit of saving more than

than the half part of coals burnt and wasted now. To this my new boiler, cannot be made any reasonable exception or opposition whatsoever, and I shall give a more ample account of its peculiar advantages in the Appendix adjoining.

But what rewards hath the world given to the first authors of the best and most beneficial inventions? Envy, jealousy, spite, contempt and all ingratitude! Every one fancies himself entitled to sport with their characters and learning, to counterfeit their inventions and call them their own! And thus was left nothing but trouble for the real authors, want of bread, and misery to the end of their lives. What can a foreigner expect, in a country and in times where nobody can be mindful, that we have one Father, and are made by one God out of the dust of the ground; but in haughtiness do despise and detest all, who are not natives, by an opinion conformable to the prejudice of the Chinese, believing that they solely have two eyes, and all other people in the world but one, and that squinted to. Therefore I want not to draw up a theme of nativity, nor to look at the rules and lines of physiognomy or chyromanty, nor to call on a fortune-teller for a prognostication; because I have my lot before my eyes, nay a great deal thereof upon my back too. Since I have made this discovery, I have suffered more troubles, abuses, and knavery than ever in all my life before, so that I have often wished, that I had never suffered myself to be persuaded to lay an hand to any trial or experiment for it. But it is done! I cannot make it undone now! Or else indeed I would.

My new invention, in the sole regard of salt-making, will be acceptable in all parts of Europe! I may go where I will! Especially where there are no coals, and the price of wood far higher than that of coals in England! Salt is wanted every where! No country can do without it! There are plenty of brine pits in the world, and I know where to find them out! And
though

though I never before bent my thoughts on that subject, nevertheless I have made myself master thereof in a very short time. The first occasion a certain gentleman gave me, desiring that I would try, whether the fine English basket salt could be brought to larger and harder crystals by a cheap method! There I was obliged first of all to search into the nature and constituent parts of salt; and then I made about twenty trials; amongst which some did fall out exceeding well, with hard, large, and very bright crystals. The brine for those trials was an artificial one, from fine basket salt and water, and if I had used a natural brine, the trials must have fallen out far better: because, what the fine basket salt had lost in the first excessive boiling and drying, I could not restore in the second. The knowledge and experience obtained thereby, was also solely the reward for my labours.

Enough salt is made in England, and no way defective; and its price lower than in any part of the world beside, that I know of. I speak here without regard to the excise, or else I must say, that it is dearer; and if it could be made by a less expence of fuel, it would be a benefit to the makers. But the untamed and unregulated liberty doth threaten more evil than good. Therefore I shall keep myself in the most narrow bounds as long as the term of my patent does last. Notwithstanding, I will say something further about the making of good and strong salt, fit for any purpose; and also of the virtue and property of salt in preserving all animal and vegetable substances from putrefaction; and lastly, of the due use of salt for the said purposes: which are matters of the greatest benefit and advantage to the public.

The strength and weakness of salt, and its firmness and solubility, are things whereof too little and very insufficient ideas and understanding is found among the gentlemen, the business of whom is concerned about the common salt and its use. If they should be asked,

asked, what is salt and its constituent parts? What is the nature, quality, property, virtue, and quantity of each part for itself, as well as in conjunction one with the other? Wherein does consist the strength or weakness, the firmness or solubility, and what are the proper causes thereof? What may be the process and operation of salt in preserving animal and vegetable substances from putrefaction? Which is the principal part in salt producing that effect? What quantity of salt is due for each and every kind of animal and vegetable substances? Can they give proper answers? Nevertheless, they count themselves masters of the business, and proceed in every case and part thereof solely at random! The spontaneous solubility in salt is commonly counted a very great fault, and no body will believe, that it is an absolute and necessary quality; without which it could be of no use or benefit to mankind. The salt lying upon fishes and meat for months, like gravel and pebbles, without melting and dissolving is counted a very strong one. Perverted sentiments!

I wish with all my heart, that they would look only a couple of minutes in the New Royal and Universal Dictionary of Arts, Sciences and Human Knowledge, and read for their cure the whole title of salt, and thankfully accept of the instructions given therein; and they would all become wiser.

God hath given to mankind two very great magazines stored with salt, which will never be wasted, but last even to the end of the world. The first is the whole sea, and the other the earth, giving at a great many places in the world, either plenty of rock-salt, or inexhaustible brine-pits.

The sea contains an inconceivable quantity of salt; but very different in regard of the zones. Under the line and torrid zones, a pint of sea-water does contain near four ounces of salt; but under the temperate zones that quantity of salt is scarcely to be found in half a gallon, and in the frigid zones not in a whole gallon.

What

What may be the reason thereof? Indeed we do know but exceeding little about the origin of common salt; and also about the operations and effects of air, and the beams of the sun, moon and stars, in the element of water! Yet it hath been observed by the curious, that the beams of the sun collected by a mirror does successively depose a kind of salt, which can be scraped off; and by a burning-glass, the beams of the moon do produce a milky matter. Some have blown with a pair of bellows in a tub full of cold water, standing in the open air and sunshine; and lastly by evaporation obtained a salt giving true signs of niter. Though now all those, and the like experiments, are of no use or profit; yet they seem to prove in some way, that the beams of the sun, moon and stars, do possess something essentially and substantially, whereof may be guessed at the reasons of the different quantities of salt under the different zones. For under the line and torrid zones the beams of the sun, moon and stars, are perpendicularly downwards, and consequently of the greatest effect, piercing through the water quite to the bottom; but under the temperate zones, oblique and sideways, and that far more so in the frigid zones.

Though the sea-water contains an inconceivable quantity of salt, nevertheless it is never alone therein, but always in company with several other matters. All physicians have demonstrated a long time since, that the sea-water contains great quantities of bituminous, nitrous, alluminous, and vitriolic matters; whereof doth proceed the bitterness and nauseousness of sea-water, producing vomits when drunk, which is not observed by drinking brine. Besides this, the sea cannot be considered otherwise, but as an universal receiver of all impurities possible to be thought of. All subterraneous waters running, or drawn out of mines of coal, allum, copperas, vitriol, and saltpetre-works, are carried at last into the sea; all filth, excrements and urine from all animals in towns and villages on

on the continent come therein together: how many tons of nastiness, filth and excrements are daily carried out of London only by the Thames into the sea? And thus out of all towns in the world by their rivers? How many millions of small and great fishes, and other innumerable inhabitants of the sea, must use it daily for their chamber-pot? What a number of mankind must take it for their church-yard, and rot therein? And also other numberless carcases. When all this is considered, then all Gentlemen, and particularly Ladies, must lose all appetite for sea-salt, and for all meat and fishes cured therewith.

It will be opposed, that the water will purify itself? It is true! But only in quantum, and of the grossest parts; but not in totum, and of all impurities and heterogeneous matters; the more subtle and subtilest remain inseparable. The art of distillery gives an uncontroulable proof. If any matter, good or bad, is done into a retort, and clean water poured into it, and distilled, the water comes as clear over as rock-water, and nevertheless it hath the taste, smell, and all other qualities of the matter left behind in the retort. If a pound of pure salt is dissolved in water, and then added to it two drams of nitre and one dram of oil of vitriol, no chemist in the world is able to part the last from the first, and bring it to its first simplicity and purity. Moreover, if one or two spoonfuls of fine salt is put into a tea-dish, and about eight or ten drops of distilled vinegar poured upon it and dried, the saline acid joins with the vegetable firmly, and the salt is of a saltish-sourness in taste. This shows, that salt will unite almost with every thing, which cannot be wholly parted again.

The sea-salt is made from sea-water by evaporation, and this either by the heat of the sun, or by fire and boiling. The first method produces a stronger salt than the latter, which loses a part of its acid by boiling; and the stronger the boiling the greater the loss; when by the first method in sunshine is lost nothing from the

acid, but is rather somewhat increased. Nevertheless, in both do remain in the end, an uncoagulable oily liquor of a bitter taste, which must be taken from the crystallized salt. Yet there remains still a good deal thereof in the crystals of salt, which also is of a dirty colour, and unfit for use or preservation from putrefaction, and therefore prohibited in several countries, particularly in Holland, by public placarts and severe penalties. But if that impure sea-salt is dissolved again in pure water, and evaporated once more in the sunshine, then it becomes a fine white and more pure salt than it was before, and is commonly counted to be the strongest among all the other sorts, and called bay-salt. But by duly considering, it will be found, that the reputed strength doth rather proceed from the admixtures of nitrous, alumnious, and vitriolic acids in the sea-water, than from the saline acid itself; which indeed is less therein, than in salt made out of brine by the shining heat of the sun, which latter is superior to any bay-salt whatever. But if the dissolved sea-salt is evaporated by gentle or strong boiling, then it will be of the same strength with the basket-salt, made by the same degrees of boiling, except what proceeds from the nitrous, alumnious or vitriolic acids being inseparable therefrom.

The rock-salt is likewise very different in all parts of the world, and very seldom entirely free from earthy impurities. In England there are only mines of rock-salt in Northwich, in the county of Lancaster. The salt is of a red colour, which proceeds from the corroded iron therein. It is dissolved in water, and the liquor in boiling purified with ox blood and eggs, both of which are sometimes stinking and rotten; thereby must be also observed certain particulars when the putrefaction succeeds well. But I know a method of purifying it without blood and eggs, and it is a method which will not cost a halfpenny in ten years. The purified rock-salt is one and the same with the basket-salt from the brine-pits in every respect, and all the difference

difference proceeds from moderate or immoderate boiling, and drying or not drying in stoves.

Of the brine pits!—The brine pits are the most noble magazines of the purest and cleanest common salt, and do deserve the most esteem and gratitude towards God the giver. And though the brine doth contain some earthy impurities, yet they are few, and very innocent, so that they do not deserve any observation or account. And if salt could be made thereof by the warmth of the sun, it would exceed in goodness and strength all bay salt whatsoever. But who will wish to live under the line or torrid zones, for the intent of salt-making, when the temperate zones give numberless advantages and benefits before the others; and can we make no salt by the warmth of the sun? Yes, enough, and more than enough, for we may make good and strong salt by fire and cheap fuel; a salt sufficient for all our purposes and intents.

How can this be done? I am wholly unable to give any better answer, than that which is already given in the new Royal and universal Dictionary of Arts, Sciences and human knowledge, under the title of salt, where it is written,

“ The salt produced from the sea-water in all parts of the world, and from the brine of all springs of the world: (when duly purified from heterogenous matters) is absolutely one and the same; but differs (accidentally) in strength and some other qualities, according to the operation by which it is made. In general, the quicker the liquor is evaporated, the weaker is the salt; the more time is employed in the process, the stronger. This is not wonderful, when we consider, that over a gentle heat, water alone, or almost alone evaporates from the liquor; but over a more violent fire, a part of the strength or acid of the salt is raised with it.”

Here is said strength or acid, which both are synonymous. The strength is the acid, and the acid is the strength of salt. Whereas that saline acid is the most

volatile amongst all the other acids, for when it is departed from its alkaline basis, it flies off in white visible fumes, and continually smoaking without the least provocation by fire, heat, or warmth, but solely of its own accord. Therefore it is no wonder at all, that by vehement boiling this acid, whereof all the strength in the salt doth depend, is driven and carried away in company with the steam, that nothing better can remain but a weak salt.

And this weak salt is also further lowered by the foolish invention of drying it in hot stoves, to make it quickly dry for the market. But such ingenious gentlemen might read and consider, what is said in the before cited dictionary, in the 10th property of salt, where is written thus :

“ Salt made extreemly dry attracts the moisture of air considerably even in the driest seasons, infomuch, that it is a common thing for people dealing in salt, to buy it at the Wyches very dry, and to sell it again many miles distant for less per hundred than it cost them ; yet they are considerable gainers ; because the same quantity of salt, that weighs one hundred at the Wyches, will be much heavier after having imbibed the moisture of the air.”

For, the crystals of salt, let them be so small as they will, cannot exist and subsist without a certain portion of water, even so small as the crystals of saltpetre. If then this natural portion of water, is in some parts driven off by extreem drying, no wonder that the salt does imbibe it again at the first opportunity : and this latter moisture out of the air being far thinner and subtiler than the first, the salt consequently must also grow moister then it was before its drying, and melt successively in water. The damage arising therefrom in the inland trade is very inconsiderable, for it is sold everywhere by weight : but in the exportation it is very considerable, and of very great hurt and damage, particularly in the exportation to the countries where the salt is sold by measure. For extreemly dry salt lays
loose,

loose, and doth heap in measure, but moist salt doth shrink, and fall together like a lump of lead, that a hundred tons by weight, do loose between 15 and 20 tons by measure. Thew no captain, having once made such a dismal experiment, will venture to make one trial more. Thus the English salt loses credit, and the evaporation decreases by the ignorance and obstinacy of men, and by their strongly boiling and drying in stoves, which is all done under the colours of English liberty, by which every one doth think, that he can do what he will.

The principal virtue and effect of common salt, for which it is always recommended and frequently used, is described in the forementioned dictionary thus: "Salt preserves all vegetable and animal substances from putrefaction, as also water, and is itself incorruptible: this properly it intirely owes to the acid it contains."

In these few lines late couched several great truths, on which we will set our mark for the preservation of all vegetable and animal substances from putrefaction. By what way and manner the salt doth bring it about, I have never heard nor read the least account. But we may come to the knowledge thereof, when we inquire for its constituent parts. But on that head in all chemistries, I know of, is scarce to be found any thing more, than what is said in the said dictionary, where in it is asserted,

"The basis of salt is mineral, which is so intimately blended with its peculiar acid, that the latter has scarce any power of exerting itself. And again, salt thrown upon burning coals greatly increases their heat. This proceeds from the air, water and acid, contained in the body of salt."

Therein it is said, that first, a mineral alkali; secondly, water, and thirdly the saline acid, are the constituent parts of the body of salt: and though there is also air in it, which is in all things, we cannot account it properly for a constituent part thereof. But how

much

much of each in quantity is contained in one pound of common salt, is not yet decided any where. The experiments thereon are very difficult and precarious too. The difference of salt, when made by the heat of the sun, or by gentle, middling, and strong boiling, causes too great differences in the experiments, that an accurate determination becomes very difficult and almost impossible. But as we know with all certainty, and also are assured thereof in all chemistry, that the constituent parts of nitre are 2 1-hf. ounces of pure nitrous acid, 5 1-hf. ounces of water, and 8 ounces of alkaline salt, which three together do compose one pound of crystalline nitre; then we may by some analogy thereof make a conclusion to the parts of common salt, and come very near to the mark. If we now consider all these three parts, then we cannot attribute to the water any effect being in question, but it must be solely accounted for a vehicle of the acid. The alkaline part, which of itself is a powerful dissolvent of all vegetable and animal substances, by which the latter are turned into jellies, and the former softened and mollified for giving out their virtues by distillation. The saline acid is of itself a very powerful dissolvent of the most fixt body of gold, which cannot be dissolved by any acid, without the help and company of the saline. Moreover that saline acid doth also volatilize all metals and minerals, particularly the silver and changes it into a Luna Cornu, or horn silver, which doth not stand in the smelting furnace, but speedily flies off. By these accounts we might become almost frightened from using any salt! But we must also know, that when the said parts are united one with the other, then they make up a third thing, which now hath all other virtues and effects as the parts, when separated, and for themselves alone.

For the easier apprehending this, I will illustrate it by an example more familiar. Soap is a compound of alkaline salt, and an animal or vegetable salt, being commonly tallow or oil. The latter of itself and alone,

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can make nothing else but spots, nastiness and foulness in all linen, woollen, and silk cloaths, and cannot be washed out by water. The alcali for itself, and far more, when it is made caustic by lime, as all soap-lee is, doth corrode all linen and woollen cloth, into a rottenness, and the silken into a jelly, that gold and silver laces, instead of being else burnt out, may be freed from all their silk, by laying them a few days in strong soap lee. But if both are conjoined by the help of water and strong boiling, till they come to a due consistence, then they both constitute a third one and a soap, which now hath all other operations and effects, as the constituent parts for themselves and alone, and become now a successful remedy of washing out of all linen, woollen, and silk cloth, all uncleanness, foulness, and greasy spots by the help of water. The animal or vegetable fatness, in the soap joins with the fatness or foulness, nastiness and spots, and the alcali joined with the first, doth turn the latter into a soapish nature, whereby they all become soluble in water, like unto the soap, and capable of being washed out.

So likewise a great change of effects is found in the constituent parts of common salt, wherein the mineral alcali is intimately united with the saline acid, that they now make up a third one, proving all other virtues and effects, as they did before when alone and for themselves; and instead of dissolving and corroding all vegetable and animal substances, they now in their union do preserve them from putrefaction and rottenness. The alcali doth dissolve and make gushing the congealed blood and serum in the animal, and the superfluous and cloged juices in the vegetable substances, as the nearest principles of a quick putrefaction and rotting; and the saline acid doth join the other solid parts, and thereof arises spontaneous separation of the constituents parts in the salt, not in totum and wholly, but only in quantum, and in part. The saline acid, joining the solid parts of animal and vegetable substances,

doth

doth keep no more from the alkali, but what it want for its substance in the said substances: and the mineral alkali with the watery parts, having lost most of their acid, do, with the small remainder thereof congealed but now dissolved, and the gushing blood and serum of the animal substances, and with the superfluous juices of the vegetables, depart and extravasate themselves from the said substances, by which means they are preserved from putrefaction. The running liquor from cured meat and fishes have a saltish taste still, yet the alkaline taste doth greatly prevail, and cannot be brought again to crystals: but by evaporation it gives a salt of a confused form, which also quickly grows moist again. This shows plainly, that the greatest part of its acid has been spent and left behind.

But we must not forget on the contrary, that the property and effect of common salt is not an absolute one, but solely a conditional one; when namely the different natures and qualities of the said animal and vegetable substances, the quality and quantity of salt, the proper management, and the time for the operation are duly regarded and applied, or else the intent will vastly fail, and the desired effect be wholly lost. This latter is proved by yearly experience. How many vessel loads of salted beef and pork are imported, and when opened found stinking and rotten? How many ships come here from Newfoundland, bringing fish wet and dropping like old rags drawn out of a river, and smelling so that no body can bear it? Whole ship loads of cured cod and salmon are often so stinking and rotten, that they are obliged to be throw overboard, before they can be brought to the destined port. All loss and damage doth fall on the owners and merchants; and those enquiring about the cause of the mischief, find all the fault is charged to the good God in heaven, and our kind mother Nature, having not given the due seasons; or the salt not being strong enough, when really all faults lie at their own doors,

doors, and proceed from their ignorance, negligence, and often from their malice too.

What can a man, having the use of sound senses, think and say of salt very difficult of solution, lying upon meat and fishes several months like gravel or pebbles, without undergoing any melting or dissolving? May we expect any due effect or virtues of common salt there? By no means at all! Instead of giving the particular reasons *a priori*, I will only show the nature and property of the vitriolic acid. This does easily unite with volatile alcalies, which latter are kept by the first strongly, that it cannot follow its inclination and fly away: if hereafter is added to the composition any fixt alkali, to which that acid has a stronger inclination, it does conjoin therewith immediately, and leave the volatile wholly alone, which then according to its volatile quality flies successively off. If lastly is added an alkaline earth, of which that acid is most fond, there it leaves again the fixt alkali, and joins freely with the alkaline earth, and forms therewith selenites, a kind of little stones indissoluble in water. Such, and almost the same thing, doth also happen with the nitrous and salinous acids, whereof I will say nothing more in particular, being afraid of giving occasion, that stones and pebbles should be made henceforth and sold under the name of very strong salt; which also would be accounted such a one by all gentlemen concerned in fisheries, being agreeable to their prejudices about strong salt; but very hurtful and pernicious to the whole community of mankind. Because, all salt wanting the property and quality of a spontaneous dissolution and melting in water, and leaving any settlement behind, must be absolutely counted unwholesome, and pernicious to all the purposes for which common salt is recommended and used, and it should indeed be prohibited by the legislature. I have seen whole vessel loads of salted meat and herrings, whereon the salt did lie like gravel or stones, and scarce any liquor at all to be seen. And also upon

salted cod-fish is found salt resembling scales and shivers of glass, refusing all dissolution. If such kind of salt is used in seasoning our victuals, and in curing our meat and fish for preservation, every one will apprehend, that therewith successively must be stoppt all our small passages and vessels of blood and serum, and therein settle as a tartarous matter, causing the gout, rheumatism, and several other evils, very common, and almost universal in these countries. What will now happen, when there is in our bodies already some disposition or inclination to the said evils, as it truly is in all persons of a phlegmatic and melancholy temper, how quickly the said evils must be increased. Moreover such a salt is wholly unfit for preserving any thing from putrefaction. Because the saline acid being solely the strength in salt, and on which the effect doth alone depend, is joined with a heterogenous matter, and forms therewith an indissoluble concrete; the alcali is then left almost alone, which for itself hath no effect for the intent, but it is rather pernicious and destructive, making meat and fish viscous, slimy and slippery, and finally stinking.

But let it be the case, that we have the best, the strongest, nay, every one a salt conformable to his wish; may we then expect great benefit and advantage, when the people is ignorant of the proper use and management? What is the gun in the hand of a soldier, if he has not learnt his exercise, nor does not understand, how much powder and lead must be taken to one charge for shooting twenty, or a hundred yards? But doth charge at random? Will he be able to hit the mark? The most part of the gentlemen concerned in the business and management of curing meat, cod, salmon, herrings and pilchards, have sufficiently proved hitherto, by their products, that they have less knowledge and understanding of the use and application of salt than a cookmaid in a gentleman's family! For if she has used too little or too much in seasoning victuals, she is severely reprimanded by her mistress. This and the
fear

fear of losing her place, makes her attentive and cautious; she does now enquire for advice here and there, and is very accurately observing the rules and manners heard of, and weighing them closely in her meditations; in every case she takes notice of the effect, and thus she brings herself to be a perfect master therein. But those gentlemen who count themselves perfect masters in the business, are not only ashamed to enquire, but also wholly impatient of corrections and instructions, and do firmly believe, they are at full liberty to do what and how they please. Their sole intent is for getting money, and of selling their ware as quick as possible, and before it doth rot in their hands: the buyer may see again how he can shift and dispose of it, whether he may be gainer or loser; and whither the people eat gout, rheumatism, scurvy and other disorders, there is no care at all. They all reject and shun the English salt, as having no strength, and wholly unfit for their business. They all call for French, Spanish or Portugal salt! But if there was not smuggled with every salt-ship a great deal of wine, French brandy, and Holland gin, the credit of foreign salt would soon starve; but quickened by the said cordials it is kept up breathing still. Besides this, there is found every where a fondness and longing for foreign things, in fashions as well as in drugs, wares, eatables and liquors. It is a common affection, or rather infection, throughout all Germany, that all foreign things are preferred, and the products of their own country despised, though really better than the others. Every one doth long for what comes from the east, south, west, and north, and what is for the mouth is not regarded. Nay, the produce of their own country will fetch double price and a quicker sale, when they only give them a French, Spanish or English name. Great absurdities! A black ingratitude towards God! An unanswerable impoverishing and ruining of the native country! And a manifest proof of being bad members

the the community. But we may look where we will, we find that distemper epidemical.

It may now be in regard of the salt as it will, I am fully assured, that every one will, and must grant me, that when the English salt is fit and sufficient for curing a sitch of bacon, or a piece of beef of 30, 40 or 50lb. that it also must be absolutely fit and sufficient for curing a fish of 1 or 2lb. and far more smaller fishes of a span long and an half an inch thick. The experience and experiment of the first is found in all farm-houses in England; and nevertheless, the latter is absolutely denied by mouth and practice in all fisheries. This is surprising indeed, and ridiculous too. Shall we herein impeach the salt, or rather the people and their customary way or method. Every one can inquire about the circumstances and parts of those ways and methods; and then further enquire how far they agree with the nature of fish, and the nature of salt and its operation in preserving animal substances from putrefaction, and then he will pronounce for the salt being not guilty. And further be enabled for chusing a more reasonable and natural method, besides the particulars to be observed. I am neither presumptuous nor rash, but assured by experiments of my own hands, that the English salt is sufficient for all intents and purposes whatsoever, and all insufficiency spoken of doth solely proceed from the misunderstanding of the people using it. When I was in my own country and household, and did kill yearly about four or five hogs, and one or two oxen or cows, for home consumption, I salted them all every year with my own hands, and it did keep perfectly good to the last bit; but having once some business upon hand which could not be delayed, my wife became shorthearted as it is commonly, I will not say universally, and would not wait, but have it salted by the butcher. In two months it did stink, and in one month more it was burried under the dunghill. One kind of salt every year, and out of one

one salt-work, and all made by strong boiling, and even so good as the English in every respect; only the hands and materials were different. I have also in Dublin cured herrings with salt bought in the next shop, having at that time no care at all of any difference of salt; and nevertheless I had success. They were as good as the Dutch new herrings, whereof the first are sold in my country a shilling a piece. I made a present to some gentlemen and ladies, and they all told me, that they had never seen nor tasted any better. A good salt herring must be fat, white, tender, and of a saltish sweetness, and not lean, hard, red, and of an alkaline biting. The English and Dutch catch their herrings in one season, and at one place, and yet the produce of both is so very different! What must be the reason thereof? The salt! Let nobody be deceived, nor deceive himself. For one part doth understand and observe the proper management and process, and the other is either ignorant of, or doth neglect it. I conclude with the absolute final decision of our blessed Saviour, Luke xiv. 34. *Salt is good! but if the salt hath lost its flavour, wherewith shall it be seasoned? It is neither fit for the land, nor yet for the dunghill: but men cast it out.* He that hath ears to hear, let him hear. If any thing is lost, it might be had before. If the salt loses its flavour, it must have had it absolutely before. And as long as the salt hath its flavour, then it is truly a good thing! a good gift from above, from the Father of lights, to whom be given all glory, power, honour, thanks and praise for ever and ever! AMEN!

A P P E N D I X.

IN the brief account of my new invention published some time since, I have given sufficient reasons for its application in all the there mentioned branches of the different businesses, and of its great benefits in saving not only a great deal of time, but also more than half part of coals and fuel, otherwise wasted. Whether in any one of the said branches of businesses may be made further, some beneficial improvement and alteration, doth seem to me a very difficult matter, if not wholly impossible; except in one, concerning the shallow boilers of the fire engines, wherein I left a small circumstance of some imperfection, which I have since amended, and the thing carried to an unexceptionable perfection. And that the courteous reader may be enabled to form a true judgment, I will set before his eyes,

I. A common boiler at present, and the same which I have taken for an example in my brief account, page 12. is neither the smallest nor the biggest, but a middling one made of iron plates.

1. The height thereof from the bottom to the flange is 3 feet, and from thence to the brim or cover again, 3 feet, and thus in all 6 feet high.

2. The diameter at the bottom 9 feet, and at the flange 12 feet.

3. The confinement of the steam 2 feet high, and contains 17 hogsheads and one half.

4. The

4. The depth of water from the bottom, to one foot above the flange, amounts to 4 feet.

5. The quantity of water doth amount to 29 hog-sheads.

6. The surface of that great quantity of water does extend to no more than 108 square feet.

7. The face of that boiler exposed to the touch of fire and flames is 161 square feet and no more. This is a very remarkable circumstance, though commonly overlooked and neglected. For the greater this is, the quicker and stronger will be the boiling, and yet by lesser fuel; but the lesser the face, the slower and weaker the boiling, and will require more fuel. Yet it must be also proved, that the fire and flames do actually touch that the face of the accounted number of square feet, which in regard of that boiler no body can undertake and effect, but a great many square feet remain very often, and others always untouched.

8. The length of the way which the fire and flames do travel from the first door to the exit into the chimney is no more than 45 feet.

9. The quantity of coals burnt and wasted under such a boiler in one week, is commonly about 20 tons.

10. The cleaning of the flue is done by a man creeping into and raking out the soot: for which purpose the boiler and flue must grow first cool, which requires a long time.

11. In this boiler are commonly burnt holes in about 4 or 5 yeats, and in 2 or 3 years more, it is past all mending and good for nothing.

12. The mending of the said holes is very difficult, must be done by candlelight, and a man creep into the flue, and counteract the rivetting of the blacksmith on the opposite side, and can be never made properly and durable. Such are the conditions of all the boilers in use at the present, wherewith now can be compared,

II. My shallow boiler, proposed in the brief account, page 14, which will be found far better and more advantageous, and is likewise made of iron plates.

1. The length is 16 feet, and the breadth 8 feet.
2. The height or depth 2 feet and an half.
3. The confinement of the steam, two feet high, and doth contain about 20 hogsheads, which is 2 1-hf. more then in the old boiler, which must not be accounted for a superfluity, but considered, that the shallow boiler hath also 20 square feet more surface of water.
4. The depth of water is half a foot, instead of 4 feet in the old boiler, which every person of true understanding will account a very great advantage.
5. The quantity of water is 7 hogsheads 6 gallons, instead of 29 hogsheads in the old boiler, which is a surprising advantage. For every one must acknowledge, that 7 hogsheads of water in a depth of half a foot, must boil sooner, and by far less fuel than 29 hogsheads, and in a depth of 4 feet; and yet from a square foot surface of the one will rise the same quantity of steam as from a square foot surface of the other.
6. The surface of the water is 128 square feet, and consequently 20 more than in the old boiler, which is a new advantage more.
7. The face of the boiler exposed to the touch of the fire and flames, is 128 square feet, which is 33 less: but this defect is compensated, 1. by the smaller quantity of water, being only 7 hogsheads instead of 29. 2. And also by the small depth of 6 inches, instead of 4 feet; 3. by 20 square feet more surface of the water; 4. by reason, that fire and flames do not leave any spot of all the 128 square feet untouched, which never happens in the old boiler. 5. Lastly, by the next following very weighty condition.

8. The length of the way, the fire and flames do travel from the first door to the exit in the chimney, is 120 feet, instead of 45 in the old boiler, which is 75 more than

than in the old boiler, which is a circumstance of the greatest advantage: for the fire and flames do tarry under the boiler almost twice as long, and produce twice as much effect.

9. The quantity of coals sufficient for firing day and night of one whole week is at the most about 5 tons, and thus 15 tons less, which is a surprising advantage and prerogative of the shallow boiler.

10. The cleaning of the flue is very light, quick and easy, and done with a broom having a long handle.

11. The burning of holes in this shallow boiler will not lightly happen before 10 or 12 years, by reasons, 1. that the fire and sulphurous exhalations of 5 tons of coals, burnt in one week, will never do so much hurt and damage, as of 20 tons of coals burnt in the same space of time. 2. That this my shallow boiler is thinly covered on the bottom with a incombustible cement, whereby the iron is defended from the injuries of fire, flames, and sulphurous exhalations of coals; which latter remedy hath been applied hitherto nowhere to any boiler by any skill and ingenuity of engineers.

12. The mending of holes, which at the last may be burnt into it, can be done light, easy and durable, that one mending will be better, and last longer than three or four, done in the usual manner.

Now every one may judge, whether this my shallow boiler, does not deserve the due esteem and preferment. I do not account it perfect, but confess freely, that it wants something, that I know of. For I am by no means deficient in mustering the defects of my inventions, and this with all rigidity, so that to Mr. Momus is left nothing more but unreasonable foolish and absurd oppositions and exceptions: and if such may be made hereafter at any time, I shall esteem them as much as the screaming of an owl. All what hath been opposed, and I heard of,

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came

came from Northumberland, where the gentlemen engineers do proudly deny, that any thing could be invented superior to what they knew at the present. O poor reasoning ! I answer them with few words in a logical axiom ; *A vestra ignorantia ad negationem rei non valet consequentia.* If they do not understand it, they may apply for advice to a school-master at a boarding-school. I don't know what I shall think of them and their knowledge : for I have in my hand original letters from a gentleman, much advanced in years, wherein he writes, " Those subjects (meaning the objects of fire engines and boilers) have been my favourite pursuit through life ;" and yet in another letter he does betray himself, writing thus : the rule to calculate the pressure of the atmosphere here is 7lb. per square inch upon the piston, the vacuum being imperfect in the cylinder, not amounting to more than after that rate. Therein does appear the wise engineer of Northumberland ! *sapienti sat !* It is a common sickness amongst gentlemen, that the smaller the knowledge and understanding, the greater is the ambition and self-conceit of their superiority to all others, who are regarded as mere blockheads ; and thus rises pride and spite, and all improving of their little knowledge and learning is stopt, and they return successively to mere ignorance ; and thus are engendered lads of an hundred years old. On the contrary, my leading maxim hath been constantly, to esteem all others wiser, and of more understanding than myself, which hath suppressed all pride, and kept me in due humility, as well as in constant encouragement to improve daily my learning and knowledge, to which I have laid solid grounds upon the best schools and universities in the first period of 26 years of my life. By that means I have united my ounce of mother-wit, with several ounces of school-wit, which enables me to make new discoveries, and to pass them through all exceptions and oppositions possible, before I let them go abroad : and if they are then foolishly attacked, I know how to defend them. And therefore

fore I say here, that my shallow boiler is absolutely preferable to all others hitherto known, and will also do all services desired and promised; and it doth admit no other exception but its shallowness, not in regard of the water, nor confinement of steam, but solely and alone in regard, that a man cannot go well into, and commodiously pick and scrape off the scurf and incrustations settling therein. But I ask all gentlemen engineers in England, which boiler, the first or second, must be accounted the most perfect and advantageous? The first, being 6 feet high, and admitting, that a tall fellow can go into, and stand therein in an upright posture, and work upon the incrustations with pick-axes, chissels and hammers, though it did require for weekly firing about 20 tons of coals, which must be burnt and wasted under it every week, whereof the charges doth not fall upon any engineer, but solely upon the proprietors, knowing nothing better: or the second being only 2 feet and a half deep or high, and not well permitting that a man can go into and scrape off the incrustations with such a commodity as it is wished; yet it is fully satisfied with a firing of 5 tons of coals per week, and gives a saving of 15 tons of coals every week throughout the whole year? Now, gentlemen, what do you answer? The first! Then the whole world will mock at you, and your employers will give you the dismissal certainly! Will you answer the second! Then all oppositions made hitherto, with all blaming and slandering are declared to be folly and absurdity! Will you say, you do not know! Then is there no farther want of witness of your ignorance and malice. I am perfectly sure, that every one of sound senses and middle understanding, must agree, that by the sole reason of burning and wasting 20 tons of coals every week, the boilers should be pulled down and cast out of doors, and instead thereof introduced and erected my shallow boilers, requiring for fire but about 5 tons of coals per week, and giving a saving of 15 tons every week, though no body could go into,

and pick off the incrustations, but these must remain therein three or four years, till the boiler was burnt intirely, without any possibility of mending it. Because it that space of four years, would be saved 3120 tons of coals, whereof the fourth part would be more than enough for buying a new one; when on the contrary, under the old boiler, by all weekly cleaning, which costs each time 2 shillings, is burnt and wasted in the same space of time, that whole quantity of coals, and the old boiler too, which by all chargeable mending it can scarcely serve one or two years longer.

But I will prove, that I have sufficient ingenuity to bring a thing, taken once into my hands, to an unexceptionable degree of perfection. This, in regard to my shallow boiler, did seem to me at first an unsurmountable difficulty, of giving unto it a greater height without losing the first and principal intent of saving more than the half part of coals burnt and otherwise wasted. Yet my constantly considering and meditating thereabout, and the obtained knowledge of geometrical proportion between grates, fire, body of flame, flues and chimnies, besides the true ideas of the draught of fire, have lately enabled me also to produce another, and intire new invention, of constructing and setting a boiler, solely appropriated to fire-engines, whereof I will give to the public in general, as well as to all gentlemen engineers in particular,

III. A most accurate and well-measured survey and description. (This is made likewise of iron-plates.)

1. The height from the bottom to the brim or cover, is 5 whole feet, which will make, with the leaden cover, when arched one foot, a measure of 6 feet, being enough for any man to go into and scrape off the incrustations.

2. The diameters do answer exactly to the diameters of the old boiler, which doth appear from the exact equality of the surface of the water.

3. The

3. The confinement of the steam in the boiler without the cover is 2 feet high, and contains 17 hogsheads and an half, which is equal to the old boiler.

4. The depth of water is 3 feet, and thus a foot less than in the old boiler, which is a great advantage.

5. The quantity of water doth amount to 17 hogsheads and 24 gallons, which is 11 hogsheads and a half less, which gives again a great advantage.

6. The surface of the water is 108 square feet, and exactly equal to the old boiler: and if sufficient in the latter, it must be absolutely sufficient in the former.

7. The face of the boiler exposed to a constant touch of fire and flame, is 183 square feet, and thus 22 more, and a very great and new advantage.

8. The length of the way, which the fire and flames do travel from the first door to its exit in the chimney, is 96 feet, and consequently 51 feet longer than at the old boiler, which is a surprising advantage.

9. The quantity of coals required in one whole week is about 5 tons, and consequently 15 tons less, which is an amazing prerogative of the greatest benefit.

10. The cleaning of the flue,

11. The long durability of the boiler,

12. And the easy and durable mending,

} are perfectly the same as in my shallow boiler, § II. see 10, 11, 12.

Now gentlemen engineers! Muster all you forces of ingenuity and ability, and say, whether it might be possible for you to raise any reasonable exception or opposition against it! But do not put the horses behind the cart! Ye must first try, whether ye can spy out, and catch the proper ideas thereof, and make a draught answering to every circumstance mentioned: for it must be counted an unpardonable folly to judge about a thing whereof ye have no idea or conceit! And lastly, you may also try, how the given dimensions may

may be contracted or enlarged ! I will allow ten years, and if the term does seem too short, then I will allow twenty more, and ye will know the last day as much thereof as at the first.

Columbus presented to his enemies and slanderers an egg, and desired them to make it stand on a polished table, which they were so vastly ingenious as to boast of. They tried all means possible, but without success, and lastly they declared it wholly impossible. Then Columbus shewed to them the possibility, as well as the very easy practicability, by a very small and almost ridiculous experiment ; and then they all cursed and swore, that they knew and could do the same thing ! But Columbus returned, " Yes, yes, gentlemen, when I have shewed you the thing ! But why did ye not do it before ?" I do present to you a thing so natural and simple as an egg and its standing upon a polished table ; but it is my new invented and last described boiler, accurately measured according to the common rule and compass, that I desire you to form an idea of, and draught conformable to that particular description ! Will it be in your power ? Yet if I were to say a few words more, you all would proudly swagger and say, you have known it a long time ago, and could do it every day ! But ye may do it now !

This my last boiler is an entire new one, and known to me solely, and in constructing as well as setting wholly different from that shallow boiler proposed in my brief account, which is now thereby degraded, and I am under an obligation of getting a new patent for the latter, if I will not lose in England both for nothing at all. But having hitherto observed an epidemic unattentiveness, regardless and surprising insensibility towards useful and beneficial inventions and proposals ; and at the right and left unavoidable troubles of battering thistles and thorn-hedges ; I began to think earnestly, whether it would not be more adviseable and advantageous for me, to let all intents of serving a
sleepy

sleepy public drop, and avoid all further trouble and
 not spend one farthing; lest after having done every
 thing due to an honest man, I must yet at the last
 complain; *Omne oleum et operam perdidit*. This last and
 very black reward, common almost every where in the
 world, I will consider some time, and weigh it exactly.
 But I am afraid before hand, that I must say as by
 weighing the guineas current hitherto; *Mene mene,*
teckel, upharfin. And then I must not let slip away the
 peremptory term of exchange. What confusion, trou-
 ble and damage hath it not caused in the English
 world! Cursed be all clipping and counterfeiting fe-
 lons! And all honest gentlemen in the whole world do
 say, Amen!

F I N I S.

If any Gentleman will favour me with a letter, he
 may use this direction: *To Mr. Charles Chrysel, at*
Mr. Lowe's, silversmith, in Mortlake, Surry: And
 my son will send them to me at any place where so-
 ever I may be in employment or business.

